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## THE ROLE OF INSECTS AND ALLIED FORMS IN THE TRANSMISSION OF DISEASES DUE TO FILTERABLE VIRUSES\*

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THE fact that there exists among horses in Minnesota an epizootic disease known technically as equine encephalomyelitis and that during the five summers preceding 1938 it affected approximately 50,000 of these animals and killed 10,000 of them on farms in this state is a matter of very serious concern for our farmers and through them it affects all of us as an economic problem.

Repeatedly during the course of the epizootic in Minnesota and elsewhere the question has been raised as to whether this disease was transmissible to man. There have been a number of instances in which this seemed clearly indicated and Eklund and Blumstein (1938) report on six cases of "an unusual encephalitis occurring among farmers in Minnesota localities where equine encephalomyelitis was prevalent." The blood serum of one of three patients was shown by Dr. Ten Broeck, of the Rockefeller Institute, to neutralize the western strain of equine encephalomyelitis. Within the last few weeks there have been additional clear-cut demonstrations of this relationship. First, Fothergill, Dingle, Farber and Connerley reported that they had recovered the virus of the equine disease from the brain of a Massachusetts child who had succumbed to a case of encephalitis, during a period when there was an unprecedented outbreak of the horse disease. This finding was promptly confirmed by Webster and Wright, who described positive findings in four additional cases. They report that the virus from the brain tissue

of human cases is highly infectious for mice by the nasal route and by injection. And now, Schoening, Giltner and Shahan, using virus originally obtained by Fothergill from the brain of a child, have infected two horses, and through failure to infect one which was immune to the so-called eastern virus, have shown that the Massachusetts cases in man are of the eastern type. Incidentally, they report that all five strains recovered by the Bureau of Animal Industry from Massachusetts horses during the outbreak of 1938 were definitely of this same eastern type.

This brings again to the foreground the question as to the method, or methods, of transfer of this and related diseases. There is general agreement today that these infections are due to filterable viruses and there are many workers who are convinced that they are transmitted in nature primarily or even solely by insects and allied forms. To what extent has this arthropod transmission been demonstrated and what species may be regarded as clearly under suspicion in this region?

It must be recognized at the outset that the problem is not a simple one. The fact that an insect is a blood sucker does no more than place it in a list of forms to be considered. The abundance of the species, its seasonal distribution in relation to the outbreaks of the disease, its ready access to diseased and healthy animals, frequency of blood meals and longevity, the ability of the virus to exist in the insect, and its particular host specificity are among the points which must be considered.

Laboratory experiments, important as they

\*A paper presented before the Minnesota State Sanitary Conference, November 4, 1938.

may be, are by no means sufficient to demonstrate that a given disease is commonly transmitted by an insect in nature. Indeed, the results obtained may be sufficient to blind workers to the possibility of other, and more important methods of spread of the disease. The type of so-called experiment which consists merely of grinding up insects which have fed on diseased animals and injecting a suspension into healthy animals, *unless supported by other conclusive evidence*, proves no more than that the minute quantity of blood which the insect may have sucked up is infective. One ten thousandths of a c.c. of blood from an animal with South African horse sickness was shown by Theiler to be sufficient to infect a healthy horse. A fully fed mosquito may contain twenty times that amount.

The studies on the method of spread of yellow fever will long remain the outstanding illustration of the development of our knowledge regarding the insect transmission of a virus disease. As far back as 1853 the French physician, Louis Daniel Beaupérthuy, though believing in the telluric origin of the disease, argued in the most explicit manner that it was transmitted by mosquitoes. Thirty-eight years later, Carlos Finlay postulated the existence of "something tangible, which requires to be conveyed from the sick to the healthy before the disease can be propagated" and reached the conclusion that the carrier of yellow fever was the mosquito known today as *Aedes aegypti*. We all know how brilliantly this work was supported and placed on a firm foundation by the American Army Commission. For more than a quarter of a century following, it was a dogma of preventive medicine that only through the agency of mosquitoes of this species could yellow fever be transmitted. Today we know that eighteen different species of mosquitoes are efficient transmitters of the virus under experimental conditions and that some of these, or others as yet unidentified, are responsible for transmitting in nature the yellow fever which lurks in the jungles. They are not only the close relatives of *Aedes aegypti* but include anopheline and culicine, as well as ædine mosquitoes. The latest reported addition to the group is *Aedes triseriatus*, a species occurring in this state and through the northeastern United States.

It must not be overlooked that Bauer (1928) demonstrated that the virus was able to penetrate the unbroken skin of a macacus monkey.

In several instances in recent years investigators have contracted the disease in the course of autopsies or of laboratory work with the virus, in the absence of infective mosquitoes.

Following quickly after the work of the Army Commission came Graham's conclusive demonstration that dengue, or "break-bone" fever, is mosquito borne. Later investigations showed that, as in the case of yellow fever, the patient was infective to the insect only during the first three or four days of the disease and that there must be an incubation period of at least eight days before the mosquito could transmit it. Graham thought that it was carried by *Culex quinquefasciatus* but later workers have considered that he was using, at least in part, the *Aedes aegypti*. In all of the subsequent work this species or its very near relative in Asia, *Aedes albopictus*, have been shown to be primarily implicated in the spread of the disease. The trend of the present-day investigations of yellow fever should warn us not to make dogmatic statements regarding other suggested vectors.

In the meantime, Theiler and various other workers turned their attention to the possibility of the dreaded South African horse sickness being transmitted by insects. Pitchford (1903), claimed that he had transmitted it by allowing *Anopheles* and *Aedes aegypti* to feed on healthy horses forty-eight hours after feeding on diseased animals. Rickmann (1911), and subsequent workers have not been able to confirm this, although it has been widely credited by field workers. Other investigators have reported direct transfer by the bites of stableflies (*Stomoxys calcitrans*), horseflies (*Tabanus* spp.), "punkies" (*Culicoides* spp.), and hornflies (*Hæmatobia*). The question has not yet been settled definitely, despite thirty-five years of intensive study.

In view of the successes which had rewarded the search for insect vectors of various diseases, virus and others, it was inevitable that attention should be directed towards such a transmitter of poliomyelitis. C. W. Howard and Clark (1912) early presented the results of studies on this phase of the problem. They dealt especially with the housefly, bedbug, head and body lice, and mosquitoes. Lice and mosquitoes were found not to take up or maintain the virus but the bedbug took it from infected monkeys and could maintain it in a living state within the body, up to seven days. The housefly was shown

to carry the virus for several days on the surface of its body.

In 1912, Rosenau and Brues announced that they had demonstrated experimentally that the disease could be transmitted from infected to healthy monkeys by the bite of the stablefly, *Stomoxys calcitrans*. Anderson and Frost, of the Public Health Service, very soon announced that they had conclusively confirmed this work and much publicity was given to the results. During the epidemics in New York State and Pennsylvania in 1913-1914, full page headlines in daily newspapers warned the public of the necessity of avoiding and destroying the stablefly.

This work has been criticized on the grounds that sufficient precautions to prevent the accidental transfer of saliva and other possible infectious material had not been taken and more rigid experiments were so uniformly negative that the theory is given little credence today. Several workers have suggested that rat fleas may be vectors under natural conditions but there is no experimental evidence to support this hypothesis and it is generally believed by investigators that poliomyelitis is usually transmitted by contact with carriers or with those patently diseased. The possibility of insects being implicated under some conditions is by no means excluded.

Still fresh in the minds of even the layman is the St. Louis epidemic of meningo-encephalitis, in 1933. According to Bredick, there were 1,065 cases with 197 deaths, or twenty per cent, up to the tenth of October. City, state and federal agencies united in an intensive study of methods of spread of the infection.

The distribution of the cases was such that water, milk and food were early excluded and control measures were based on the belief that it was a virus disease transmitted through nasal secretions. Nevertheless, very serious attention was given to the theory that it was mosquito borne for, paradoxical as it seems at first thought, the worst drought in the history of St. Louis County had resulted in a veritable plague of mosquitoes. The explanation was that the numerous small rivers and streams of the region nearly dried up and not only created unusually favorable pools and sluggish currents, but reduced the natural enemies of the insects. The investigation of the possible rôle of mosquitoes in transmission was further stimulated by the results already ob-

tained in experimental studies of equine encephalomyelitis.

All attempts to implicate mosquitoes, stableflies, houseflies, fleas or other blood-sucking insects were negative.\* It cannot be claimed that the conclusions were final but there is little reason to suppose that arthropod transmission plays a significant, if any, rôle in the spread of meningo-encephalitis in man.

When it comes to the problem of equine encephalomyelitis there is tangible evidence that mosquitoes and, possibly, other arthropods, must be considered as incubators and potential carriers of the infection. This evidence we shall review briefly and then consider more particularly the local situation as regards possible vectors and their control.

Haring, Howarth and Meyer (1931), the first to definitely describe the disease, mention the possibility of its being spread by insects, and Meyer (1932), noting that the virus circulates in the blood, says: "Hence the rôle of biting insects deserves consideration." He also, at this early date, mentions three suspected cases in men handling infected horses but did not have available brain tissues for testing for the virus.

In connection with this pioneer work, Herms, Wheeler and Herms undertook studies of possible arthropod vectors. In a very carefully planned series of experiments they tested the hornfly, *Hamatobia serrata* (= *Lyperosia irritans*), a horsefly, *Tabanus punctifer*, the stablefly, *Stomoxys calcitrans*, and two species of common mosquitoes, *Aedes dorsalis* and *Anopheles maculipennis*. Only negative results were obtained.

Except for the work with mosquitoes, the tests by Herms, Wheeler and Herms were conducted in 1932, though not published before October, 1934. In the meantime Kelser, in 1933, had announced that he had succeeded in transmitting the virus of equine encephalomyelitis from an inoculated guinea pig to a horse by the bites of *Aedes aegypti*. Mosquitoes fed on the horse during the period of high temperature and subsequently fed on a normal animal likewise produced the disease. The mosquitoes were infectious as early as the sixth day after feeding on the diseased animal.

An important contribution by Giltner and Shahan (1933) showed that there were two strains

\*The epidemiological study of St. Louis encephalitis by Casey and Brown (*Science*, November 11, 1933) concludes that "Every known feature of its epidemiology is common to mosquito borne diseases." Experimental evidence is not adduced.

of the virus, a western and an eastern one, which were serologically and immunologically distinct. The eastern type is much the more virulent and is rather narrowly limited, but the western type has spread eastward.

In 1934 Merrill, Lacaille and Ten Broeck reported that both strains were transmissible by the salt marsh mosquito, *Aedes sollicitans*, and the western strain by *Aedes cantator*. Ten Broeck and his associates followed this with a series of papers in which they presented critical data relative to the period of infectivity of the horse and the multiplication and persistence of the virus within the insect host, and Madsen and Knowlton (1935), working in Utah, demonstrated that two species of native mosquitoes, *Aedes nigromaculis* and *Aedes dorsalis* were capable of transmitting the western type of virus from infected to healthy mosquitoes.

Of special interest to residents of Minnesota is the fact that Kelser, in 1935, was able to infect one of three guinea pigs by bites of *Aedes vexans*. Unfortunately, this work was interrupted by removal to Panama, where experiments were continued with another species, *Aedes taniorhynchus*, which proved capable of transmitting the western, but probably not the eastern, strain of the virus. A single mosquito biting a normal guinea pig but once, produced encephalomyelitis and death of the pig in five days.

In the meantime Simmons, Reynolds and Cornell (1936) reported successful transmission to guinea pigs of the western type virus by *Aedes albopictus*, an Asiatic species closely related to *Aedes aegypti*.

To date, then, we have proof that at least eight species of *Aedine* mosquitoes are able to take up, incubate, and convey, under laboratory conditions, the virus of equine encephalomyelitis. These are *Aedes aegypti* ("Stegomyia"), *A. albopictus*, *A. cantator*, *A. dorsalis*, *A. nigromaculis*, *A. sollicitans*, *A. taniorhynchus* and *Aedes vexans*. That several of these play an important rôle in nature cannot be doubted, although it is far from established that mosquito transmission is the only, or even the most important method of spread of encephalomyelitis to animals or to man.

Of the eight species listed, *Aedes vexans*, *Aedes dorsalis* and *Aedes nigromaculis* occur commonly in Minnesota. Overwhelmingly dominant in most parts of the state is *Aedes vexans*, a marsh-breeding species, which is noted for its

migratory habits. In the course of studies aided by WPA on the pest mosquito problem of the Minneapolis-Metropolitan Area this past spring and summer, we found 98.28 per cent of the 337,960 mosquitoes trapped and identified were of this species. *Aedes dorsalis* was represented only to the extent of 0.26 of one per cent and *Aedes nigromaculis* by 0.01 of one per cent. These figures would vary, dependent on local conditions, but the great dominance of *vexans* remains as great in the regions where the three species are common.

*Aedes vexans* is known to deposit its eggs in low-lying ground where they may lie dormant not only for the remainder of the year but even for several years, until heavy rains create temporary pools which persist until the developmental cycle is completed. In warm weather this period may be as brief as four or five days. On emergence, the adults readily migrate for a distance of fifteen miles or more.

The vast areas of low-lying ground suitable for breeding places but not readily identifiable as such until there come periods of excessive rains, the value of the marsh hay and other crops of such areas, the expense of extensive drainage operations and the conflicting interests of various groups, make the problem of control of this and related species a difficult one which cannot be considered in detail at this time. In our urban areas a considerable reduction of pest mosquitoes will result from normal growth and from careful consideration of the problem in connection with planning for parks, lakes and streams, reservoirs and similar developments.

To the present no mention has been made of other possible vectors of the disease, though many insects have been submitted to us with the inquiry as to whether they are of importance in this respect. Some of them such as plant feeding leaf-hoppers, or spittle insects, could be immediately dismissed because of their habits and their distribution. Horseflies cannot be regarded as unworthy of consideration. They have been shown definitely to be direct carriers of anthrax and of several protozoal infections, but there is no experimental evidence incriminating them in the case of encephalomyelitis.

Some species of *Simulium* flies, commonly known as buffalo gnats, turkey gnats, or black-flies, are vicious blood suckers and there are notable instances of their attacks resulting in the



death of large numbers of horses, mules, cattle and hogs in the Mississippi Valley. Whenever they are abundant, many young chickens and turkeys succumb to their attacks. In spite of numerous suggestions that the deaths of these various animals are due to a virus transmitted by the Simulium, the whole picture is such as to support the view that the fatalities are due to the poisonous saliva injected by enormous hordes of attacking insects. The distribution of the species attacking horses does not in anywise correspond with the geographic distribution or observed characteristics of the spread of equine encephalomyelitis.

In view of the ease with which the infection is transferred experimentally by nasal secretions, one cannot entirely rule out the possibility of mechanical carriage by houseflies, stableflies and similar insects, but if it occurs, it must be exceptional.

Syvertson and Berry (1936) report the transmission of the western strain of the virus to Richardson's ground squirrel by ticks which had engorged as nymphs for forty-eight hours on infected guinea pigs. The evidence is altogether too scant to justify drawing conclusions from these results but they raise anew the question as to whether there is a reservoir host which maintains the virus in nature. Certainly this transmission cannot account for the spread of the disease in a more direct manner.

By way of summary, it may be said:

1. That the epidemiological evidence indicates

that arthropod vectors play a rôle in the spread of encephalomyelitis to animals and to man.

2. Mosquitoes of the genus *Aedes* most nearly meet the requirements for this transmission and there is conclusive experimental evidence that they are capable of taking up, incubating and increasing the virus, and then transmitting it to healthy laboratory animals and to horses.

3. There is no satisfactory evidence that other arthropods are implicated, unless under very exceptional conditions.

Difficulties in the way of accepting the theory that ædine mosquitoes are the most important carriers are:

1. In spite of numerous attempts, infective mosquitoes have never been found under natural conditions.

2. Our native ædine mosquitoes, and specifically, those shown to be potential carriers, do not winter as adults. Since diseased horses are infective to mosquitoes only in the first few days, there must be some explanation of the survival of the infection over winter.

3. The possibility of ticks being effective transmitters under natural conditions is very remote.

4. The readiness with which the virus is transmitted by the nasal route suggests that in the case of encephalomyelitis as in that of poliomyelitis, there are important methods of spread, other than by arthropods, even though mosquito transfer is clearly possible.

## INFLUENZA, RABIES, AND ENCEPHALITIS\*

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**D**URING the past decade great advances have been made in the study of virus diseases. Quantitative methods of studying immunity and physical methods such as the use of the ultra centrifuge and ultra filtration have been introduced.

Growth of virus in tissue cultures and on the chorio-allantoic membranes of the developing chick is receiving much study and is used

both for isolation and preparation of virus for vaccine. This latter point is of great interest. Vaccine used for immunization against virus diseases at present contains much foreign material, and growth of virus in tissue culture cuts this to a minimum.

During the past year the State Board of Health has been especially interested in three of the virus diseases: influenza, rabies and encephalitis.

\*Read at the Minnesota State Sanitary Conference, November 4, 1938, Minneapolis, Minnesota.

### Influenza

About a year ago an influenza research laboratory was established in the State Department of Health.

The history of influenza virus research is very recent.

In 1931, Shope reported isolation of a virus which, in conjunction with *H. influenzae*, suis, has caused influenza in swine in the middle west each fall since 1918.

In 1933, Laidlaw, Smith, and Andrewes reported isolation of a virus from human cases of influenza by means of intranasal inoculation of ferrets. They showed it to be closely related to the swine influenza virus.

In 1934, Francis reported isolation of the same virus from human influenza patients in Philadelphia and Puerto Rico.

In 1936, human influenza virus was transmitted to man accidentally from a ferret and produced clinical influenza. Russian human volunteers were infected by the human influenza virus. Influenza virus has been isolated in Russia, Germany, Australia, Alaska, and various parts of the U. S. A.

Strains of virus, while very closely related, do show a difference. Many problems need study:

1. There is the question of the existence of different strains which is of great importance in the production of vaccines.
2. Not all influenza-like diseases yield, on study, an influenza virus, yet some resemble influenza so closely in every respect that it seems certain they must be due to a virus, which, however, may be different from the influenza virus now known.
3. Clinically, it would be desirable, if possible, to differentiate the members of the influenza group from which it is possible to isolate a virus, from the rest of the group. Careful clinical studies are needed in association with influenza virus studies.
4. The whole group of respiratory diseases, included under the term "cold" and upper respiratory infection, need study from virus standpoint.

Present studies here are limited to those carried on in institutions since it is possible to study the clinical side better in such surroundings.

### Rabies

We have been free from rabies since 1931 with the exception of one case in 1933 in a dog imported from Texas. This year, since May 4, positive diagnosis of rabies has been made in 105 dogs and 2 cattle. One hundred and sixty-nine people who have been in contact with the animals have taken rabies vaccine, and of these, thirty-one are said to have been bitten or scratched. In the lay mind, rabies causes greater apprehension than any other disease, and because of this, treatment is often demanded where degree of exposure does not justify treatment. Before giving antirabic treatment, the physician should question the patient carefully as to the type of exposure and type of lesion and examine the patient for lesions through which saliva may have entered. Risk of serious reactions from rabies vaccine, while not great, should be borne in mind when considering the use of antirabic vaccine in cases where exposure is slight.

Although rabies is a disease long studied, problems in connection with the disease still require study:

1. The evidence of various strains and the question of various clinical forms of rabies in different outbreaks in dogs.
2. Incidence in various wild animals, and question of reservoir in wild animals.
3. Use of mice makes possible a study of immunity following the use of various types of vaccine, both in men and animals. Over 200 people have had rabies vaccine. Opportunity exists for study of immunity in them. A better vaccine is still desired, one which gives higher immunity and less reactions. It is hoped that it will be possible to study some of these problems here.

### Encephalitis

During the past five years, great advances have been made in the study of encephalitis. Up to 1933 the diagnosis of encephalitis of the non-suppurative type was clinical and pathological. The history of encephalitis is quite recent.

In 1917, Economo reported clinical and pathological findings in cases of encephalitis occurring in Austria. The disease has been often named after him although epidemic or lethargic encephalitis is the usual name now used. In 1918 and 1919 and the early '20's, there was a

great deal of this type of encephalitis reported. The disease has tended to occur sporadically since this time. This type of encephalitis has its greatest incidence in winter and spring and affects the younger age groups, fifteen to forty-five years of age. The disease is of slow onset, with low fever. It has a protracted course and numerous sequelæ. Eye muscle paralyses are common. Mortality is uncertain because of the existence of mild or questionable cases but is probably about 20 per cent. At the time the disease first appeared there were reports of transmission to animals and that it was due to a filterable virus. No further work was done.

In Japan, epidemics of another type of encephalitis have been occurring since 1871. The greatest epidemic occurred in 1924. It has been called summer encephalitis, because it occurred when the hot months were drawing to a close. It is acute in onset and short in course. The cranial nerve paralyses, so common in the Economo type, are rare in this type. Mortality has been, however, 60 to 90 per cent in various epidemics. The incidence and mortality increased directly with age. Sequelæ were few. The Japanese suggested that Economo encephalitis be called Type A, and that this be called Type B.

In 1933, an outbreak of encephalitis occurred in Missouri in St. Louis County and City. Over one thousand cases were reported. It started in July and the peak of incidence of disease occurred in late August. It resembled the Japanese type closely in time of appearance, age incidence and clinical course. There was sudden onset with headache, nausea or vomiting, and a temperature of 104-105°. Then there was drowsiness which might proceed to coma, or instead there might be delirium or restlessness. There was usually a short course, and the mortality was about 20 per cent. The sequelæ were few. Neurological findings outside of stiff neck and positive Kernig were not striking. There may have been absent abdominal reflexes, positive Babinski, or changed tendon reflexes. Paralysis of cranial nerves was uncommon.

A virus was soon isolated by Muckenfuss, Armstrong, and McCordock, and shortly after by Webster at the Rockefeller Institute. Monkeys and mice were found susceptible. It was shown that protective antibodies were present against the virus in blood obtained from convalescents.

In 1937 a similar epidemic occurred in St. Louis, and the same virus was again isolated.

In 1934 and 1935 other epidemics occurred in Japan and a virus was isolated that was shown to be distinct from the St. Louis type.

### Equine Encephalomyelitis

*Western Strain.*—In 1931, Meyer, Haring, and Howitt reported the discovery of a virus as the cause of an epizootic of encephalomyelitis among horses and mules in the San Joaquin Valley of California during the summer of 1930.

In 1933 the disease appeared along the eastern seaboard. In this year, TenBroeck and Merrill, and Biltner and Shahan reported the isolation of an eastern strain of equine encephalomyelitis virus which, though similar to the western strain, differed serologically. The disease in horses was more acute and fatal and the virus appeared to be more virulent for laboratory animals than the human strain.

The viruses of equine encephalomyelitis differ immunologically from the viruses of lymphocytic chorio-meningitis, the St. Louis type of encephalitis, Borna disease, vesicular stomatitis and poliomyelitis.

Present epidemiological and experimental evidence points to spread by an insect vector and not by contact. Experimentally, mosquitoes can be infected and transmit the virus to laboratory animals and horses. *A. ægypti*, *A. sollicitans*, *A. nigromaculis*, *A. dorsalis*, *A. albopictus* Skuze, *A. vexans*, and *A. tæniorhynchus*, can transmit the western strain; *A. cantator* and *A. sollicitans*, the eastern strain. To date no one has found infected mosquitoes in localities where equine encephalomyelitis is prevalent.

Meyer, in 1932, suggested the possibility of human infection from the equine strain. He briefly reported three cases of encephalitis occurring in men closely associated with horses having encephalomyelitis. No virus was isolated or protective antibodies demonstrated.

Equine encephalomyelitis was very prevalent in Minnesota during the summer of 1937. During the last week of August and the first two weeks of September 1937, six cases of human encephalitis, all farmers, were reported from a county in Northwestern Minnesota. Five had had contact with sick horses. The sixth had had no contact with sick horses at the time of onset of his illness. He drove a tractor on a farm

## EMERGENCY TREATMENT OF INJURIES—LEE

in North Dakota not far from the Minnesota border. There was much equine encephalomyelitis in this locality.

Blood was collected from three of the recovered patients during January 1938. Dr. C. TenBroeck of the Rockefeller Institute demonstrated neutralization of the Western strain of equine encephalomyelitis virus by one of the sera. Blood was collected again in May 1938 from this patient and neutralization again demonstrated by Dr. TenBroeck. This was the patient who had had no contact with sick horses and had been sick about three weeks.

Four mosquitoes shown to transmit the western strain occur in Minnesota: *A. vexans*, *A. nigromaculis*, *A. dorsalis*, and *A. tritaeniorhynchus*. Of these only *A. vexans* is a common mosquito.

**Eastern Strain.**—In late August and early September 1938, equine encephalomyelitis invaded southwestern Massachusetts for the first time. At the same time a highly fatal encephalitis among children appeared. Only meager clinical reports have been made to date. Drs. Fothergill, Dingle, Farber, and Connerly at Harvard isolated the eastern type of equine encephalomyelitis virus from the brain of a patient.

Drs. Webster and Wright at the Rockefeller Institute confirmed this, and in addition isolated the virus from the brains of four other patients. In addition, virus was sent to the Division of Animal Husbandry at Washington, D. C., and the above work was confirmed, using horses as experimental animals.

### Summary

In summary, under the infectious non-suppurative type of encephalitis, the following known types of virus may be listed:

1. Economo or lethargic encephalitis, probably caused by virus.
2. Japanese type, virus isolated, protective bodies present against it in the serum of recovered patients.
3. St. Louis type, virus isolated, protective bodies present against it in the serum of recovered patients.
4. Encephalitis caused by eastern and western strains of equine encephalomyelitis virus, protective bodies present against them in the serum of recovered patients.

NOTE: After presentation of the above paper, isolation of the Western strain of virus from the brain of a twenty months old child was reported by Dr. B. F. Howitt of California.

## EMERGENCY TREATMENT OF INJURIES\*

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THE susceptibility to injury is universal; there is no immunity. The treatment of the injured is chiefly the concern of the medical profession but not of the surgeon alone. This is especially true in smaller towns and rural communities. In the larger cities and industrial centers the major portion of the care of the injured has fallen to the general surgeon. In the last decade or two the industrial injuries at least have passed largely into the hands of the industrial surgeon. Even the laity must assume some responsibility in emergency treatment of injuries. It is not only frequent but almost the rule that some immediate care is rendered by laymen before skilled medical service is available. Many industrial plants and commercial institutions employ a lay person with some instruction in first aid. A nurse is frequently employed for

this purpose. I am certain that the morbidity in accidental injuries has thereby been reduced. The public generally has been enlightened along many medical lines, but I believe that with such general and only superficial information as we can broadcast, the importance and necessity of skilled medical care for every type of injury should be stressed. It is often the apparently insignificant but neglected puncture wound which leads to disaster. In my short discussion, I shall make no attempt to describe detailed surgical procedures applicable to the endless number of specific injuries which we encounter. I shall attempt rather to review and discuss certain principles of treatment applicable to types of injury, surgical principles most of which are neither new nor original but which, like a prayer, may bear repetition. For the purpose of this paper, injuries may be classified roughly according to anatomic location such as:

\*Read at the annual meeting of the Minnesota State Medical Association, Duluth, Minnesota, June 30, 1938.



1. Head injuries
2. Injuries to chest and abdomen.
3. Injuries to the back.
4. Injuries to the extremities.

Injuries to the extremities are by far the most common and therefore of great importance, both from this and an economic standpoint. The symptoms and signs of injury requiring our immediate attention are: pain, hemorrhage, and shock.

Pain naturally varies in degree depending upon the severity and location of the injury, and the susceptibility of the individual to painful stimuli. There are certain portions of the body surface such as the lips, fingers, external genitalia, and the perianal region which are more richly innervated with pain fibers than are others. Likewise, there are some organs more sensitive to pain than others. For instance, bones give rise to pain more readily than do muscles. The sensitivity of the testis and blood vessels forms a tremendous contrast to the relative insensitivity of the fascia, cerebral cortex, and cartilage. The difference in susceptibility to pain in individuals is well recognized. Paralleling this phenomenon there is also the well known fact that there is a marked difference in susceptibility to drugs among individuals.<sup>3</sup>

Hemorrhage may be from the gaping margins of an open wound, into deep structures, or into closed cavities such as the cranial, thoracic, and abdominal. The natural processes which come into play to control and to arrest hemorrhage often do not suffice and then the surgeon must resort to artificial methods of controlling hemorrhage. Intravenous injections of calcium chloride or repeated small transfusions of whole blood may be indicated. At times, there may be troublesome bleeding from arteries which do not permit clamping or transfixing. In such a case a piece of fresh muscle rubbed on a piece of gauze and quickly applied will often promote clotting. Recognition of internal hemorrhage is often difficult. Here, the careful observation of blood pressure is of help. An increasing pulse rate should lead one to suspect bleeding. Pallor, anxiety, restlessness, and thirst are signs of continuing hemorrhage. Obviously, its control is urgent.

Shock is not always easy to differentiate from severe hemorrhage. In shock, however, the onset is usually abrupt. The patient is apathetic, but

not unconscious. There is no restlessness or anxiety, but rather, indifference. The temperature is subnormal, and there, too, the blood pressure is low. The treatment is external heat, judicious use of morphine (except in head injuries), elevation of the foot of bed, and blood transfusions.

The emergency treatment of injuries then, generally speaking, resolves itself into: (1) the management of symptoms as they present themselves; and (2) to the more deliberate and planned treatment of the injury itself. This planned treatment must consist of careful examination of the injury by inspection, frequently palpation, demonstration of function or loss thereof, and x-ray examination. The importance of this step is obvious. Many wounds have been sutured leaving severed tendons or nerve trunks unrecognized beneath the sutured skin. Foreign bodies in the depth of the wound are frequently over-looked. Fractured bones may be left unreduced and unsplinted. The next logical step is directed toward the prevention of infection in the clean wound and to combat infection in the contaminated wound. The former is accomplished by strict attention to asepsis, such as the proper preparation of the surgeon's hands, the wearing of a mask covering nose and mouth, a surgeon's cap, and aseptic care of patient's skin surrounding wound. This last is accomplished by careful cleansing of the skin with soap and water,<sup>8</sup> great care being taken not to wash dirt into the open wound. This can be done by carefully covering the wound with sterile dressings, and when an extremity is involved it should be raised as the skin proximal to the wound is cleansed and lowered for the washing of the region distal to the wound. The clean wound is then swabbed with an antiseptic which will not damage the tissue cells by precipitating protein. For this purpose I prefer one of the newer organic mercurial germicides. The wound is then closed not too tightly, loose dressings applied, unless temporary pressure is required to control bleeding.

The contaminated or potentially infected wound must receive the best care the surgeon's skill and experience can muster. How frequently we have seen extensive crushing lacerated wounds tightly sutured and snugly bandaged without proper preparation, and consequent disaster. The proper treatment of such a wound,

after adequate examination, should consist in not only proper preparation of the surgeon as for a major operation but meticulous cleansing of the wound itself as well as the surrounding skin. This is accomplished again by thoroughly cleansing of the wound with neutral white soap and water or normal salt solution,<sup>10</sup> débridement of the devitalized skin and muscles, insertion of Carrel-Dakin tubes, and leaving the wound open or only partially closed, with loose dressings, immobilization, elevation, and irrigation every two hours with Dakin's solution.

Severed tendons and nerves should be sutured as early as possible. For this purpose, fine silk is recommended.<sup>8</sup> This applies at least to reasonably clean wounds or where there is a reasonable likelihood that the wound will heal without any severe infection. In contaminated wounds a secondary suture is advisable. A period of at least three weeks must elapse after the original wound is completely clean and healed. Suture of the extensor tendons on the dorsum of the hand to about the proximal phalanges offer the best prognosis.<sup>11</sup> Here, if the gap is not too great, union may occur even without suture. These tendons are free, isolated, and accessible. In the case of the middle phalanx of the fingers division of the tripartition of the extensor aponeurosis with its different insertion for each partition, causes a quite characteristic and prognostically very unfavorable injury. Injury to the flexor tendons of the hand and fingers offers a worse prognosis due to their ensheathed condition. In addition, the palm of the hand shows a structure very appropriate for the protection of sensitive structures, but very inappropriate surgically. Tendons should be sutured within six hours from time of injury if primary suture is done. The part should be immobilized for ten or twelve days in position to relieve tension, and splinted for three weeks. Essentially, the same rule applies to both severed tendons and nerves.

The treatment of localized infections and frankly infected wounds is not ordinarily considered emergency treatment, but frequently patients with such conditions do not seek any medical care until infection is well established. The treatment may depend somewhat on the location of the infection. In general, a spreading infection should be allowed to localize before any incision is made.<sup>6</sup> Infections about the face, mouth, and neck should be treated very con-

servatively. Blair has stated that he has never seen a fatality in such a case treated conservatively, that is, where the infection has not been pinched, punctured, or incised or otherwise traumatized. The treatment should consist of application of heat, ultra-violet rays, rest, and fluids. Sulfanilamide may be indicated. Infected wounds and spreading infections in other locations are also best treated by hot packs consisting of light moist dressings kept warm with a heat cradle or lamp, and elevation. The matter of hot packs is of some importance in its application. These are best applied as light moist dressings kept warm with a heat cradle, frequently moistening the dressings with sterile water, normal saline, or boric acid solution. Frequently, hot packs are applied in great bulk. These gradually cool and before long the wound is enveloped in a cold pack. The purpose of the hot pack is to produce active hyperemia and this is facilitated by elevation of the extremity to relieve the passive hyperemia.

Ochsner's solution, properly applied, is of definite therapeutic value in spreading infections with lymphangitis and induration.

X-ray treatment of infections is apparently of real benefit.<sup>4</sup> Koch<sup>8</sup> gives a half erythema dose and has found this to be of definite value.

Localized infections and tendon sheath infections require immediate incision and drainage. Hot packs, as described above, and elevation is indicated.

Recently, Wangenstein at the University of Minnesota, has described treatment of acute infections by rigid immobilization of the extremity in plaster-of-Paris casts holding the extremity in elevation. He has shown that this type of treatment is of definite value.

Burns, especially if at all extensive, are best treated by the so-called tannic acid treatment. This was introduced by Davison about twelve years ago. Bettman has recently modified this treatment to the extent of applying silver nitrate after the application of tannic acid.<sup>5</sup> The technic of this treatment consists, first of opening all blebs, removing all burned and necrotic tissue, cleansing the burned area of grease and dirt, then spraying the burned area with a freshly prepared 5 per cent aqueous solution of tannic acid and following this with application of 10 per cent silver nitrate with cotton pledgets. The patient is then placed on a sterile sheet and a

## EMERGENCY TREATMENT OF INJURIES—LEE

heat cradle applied over the body. For small burns, I personally prefer nupercainal ointment. This relieves pain promptly, dressings do not stick to the wound, no heavy crusts form, and the wound is easily kept clean.

The emergency treatment of chest and abdominal injuries is an extensive subject in itself and will be discussed only briefly. (A recent article by Karl Meyer is made free use of.) Practically all penetrating wounds of the abdomen should be explored as soon as possible, taking into consideration, of course, the patient's general condition. Hemorrhage and shock must be treated first unless it is apparent that there is rapid and extensive internal hemorrhage which only immediate operation can control. Perforations of the bowel and stomach produced by stab or bullet wounds are closed. The most rapid method of accomplishing this is to make a long paramedian incision and at once eviscerate the intestines into warm wet towels. Small to moderate sized wounds of the liver are best sutured with catgut through pieces of muscle excised from the abdominal wall. Muscle may also be inserted into the wound cleft.

Both surfaces of the liver must be repaired. Large wounds of the liver must be tamponed with gauze, left as a drain, and a snug bandage applied about the abdomen for pressure.<sup>7</sup> Such abdominal wounds are not drained; only the abdominal wall. Wounds of the spleen of any degree are best treated by splenectomy. Wounds of the pancreas are sutured or tamponed and drained. In suspected rupture of the urinary bladder Butler recommends, if the urine contains blood or if no urine is obtained by catheter, the injection of 500 c.c. of 5 per cent sodium iodide solution and x-ray to make a positive diagnosis.<sup>1</sup> Wounds of the urinary bladder are closed with catgut in two layers and the bladder kept empty by means of a retained catheter for six or seven days.

In injuries of the chest it should be kept in mind that half of the ribs cover the abdomen so that penetrating wounds below the fifth rib must lead one to suspect injury to abdominal viscera. The usual policy in penetrating wounds of the lungs is conservative management.

Head injuries may vary from minor lacerations of the scalp to extensive skull fractures with varying degrees of brain injury. Severe head injuries must be treated by bed rest, ex-

ternal heat, intravenous administration of 50 to 150 c.c. of dextrose solution, probably lumbar puncture and drainage reducing the pressure 50 per cent and limitation of fluids.<sup>2</sup>

Craig advises against the use of morphine in severe head injuries.<sup>2</sup> He recommends the use of barbiturates. Sodium amytal intravenously may be given for quieting. The closest observation is indicated. I am omitting from my paper any discussion of back injuries and fractures.

### Summary

1. Some general knowledge of first aid treatment of injuries on the part of the public is important.
2. All injuries should receive the most careful care in regard to general cleanliness and asepsis.
3. Skilled surgical care is indicated in all types of injuries.
4. Experience and judgment are important qualifications in determining the type of treatment indicated in infected wounds.
5. Immobilization, elevation, and heat are important therapeutic measures in treating injuries and infections.

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### Discussion

DR. BENJAMIN F. DAVIS, Duluth: Amidst the avalanche of advice as to what to do, especially in certain classes of industrial emergencies, basic principles of surgery are frequently lost sight of. The demand to do something is so great that many times a something is done just because it is the fad of the moment, or worked out well in a previous case, regardless of the indications which a proper analysis of the particular case to be treated would show.

Consider the matter of wound infections. The arguments as to the type of disinfectant, if any, to be used, the type of drainage to be employed, how to apply hot moist dressings and so on are beside the point and of minor importance. The question is, how long an interval has elapsed since this wound was in-

flicted, what is the character of the wound and what is the degree of contamination? Wounds seen within twelve to twenty-four hours of their infliction are in the stage of contamination. The bacteria are on the surface and careful mechanical cleansing of the wound with removal of devitalized tissue very frequently will permit of primary closure and primary union. Wounds seen in the next twelve to twenty-four hours will be in the stage of invasion. Bacteria may have penetrated beneath the surface cells and have been carried into the deepest recesses, and mechanical cleansing, other than complete debridement, may not suffice to remove all such organisms but probably will greatly minimize the degree of subsequent wound infection. Wounds seen after forty-eight to seventy-two hours, will almost certainly be in the stage of established infection. Mechanical cleansing will accomplish little, but adequate drainage, if infection is established, is essential.

The immobilization of infected wounds either by splints or casts is of prime importance and the essayist is to be commended for emphasizing a point which is too often forgotten.

Consider, now, the matter of head injuries, particularly when associated with loss of consciousness. Here, more than in any other field of industrial surgery, the temptation to fit the patient into some special form of treatment rather than to make the treatment fit the patient seems to be well nigh irresistible. Each case of head injury, with loss of consciousness, must be individualized. Frequent observations on the condition of the pulse, the respiration, the rectal temperature and the state of consciousness should be made. In the majority of instances, it will be possible, by this means alone, to estimate the danger of mounting intracranial pressure fairly accurately and to determine when surgical decompression becomes necessary and when less radical measures may suffice. I can best illustrate this idea by the means of two case histories:

*Case 1.*—This patient fell while in an alcoholic state, and struck his head against a curbstone. He was unconscious for five minutes, but on admission to the hospital his state of consciousness was good, his respiration normal, his temperature by mouth 99.6° F.,

and his pulse 60. He was discharged on the eighth day after his accident, "feeling fine except for slight headache," with his state of consciousness good, his respiration and temperature normal and his pulse 56. The following morning, however, this patient returned to the hospital, complaining of severe headache and vomiting. His state of consciousness, respiration and temperature were as before, and his pulse rate was 60. After thirty-six hours of rest in bed, the pulse rose to the seventies and the headache and vomiting ceased. This was a case of head injury with concussion, a moderate increase of intracranial pressure, well compensated (note the moderate bradycardia), and required no complicated or radical treatment.

*Case 2.*—This patient had had a mild headache for one week. Immediately after making a sudden effort, she clasped her hands to her head and complained of a sudden, severe headache. This was immediately followed by a clonic convulsion and unconsciousness. On admission to the hospital, the patient had regained consciousness; her temperature was 97.4° F., her respiration 29, her pulse 64. The spinal fluid was bloody. The patient became drowsy and gradually stuporous, as the pulse dropped to 48 and the respiration to 10. Breathing became of the Cheyne-Stokes type. This condition persisted for approximately 24 hours, when, without other change, the temperature rose to 100, the pulse to 140 and the patient died. Autopsy disclosed hemorrhage from a ruptured aneurysm of the right middle meningeal artery. This was a case in increasing intracranial pressure finally extending beyond the limits of physiologic compensation; the physiologic signs demanded radical treatment, but were disregarded.

I believe that each of these cases is typical of a certain group of head injuries and that in each the clinical story is clearly told by the obvious physiologic changes, which also clearly indicate the treatment demanded.

I am not taking issue with the essayist on any of the points which he has raised in his excellent paper. It is my purpose to stress the necessity for properly analyzing and diagnosing the conditions to be met and making the treatment fit the patient rather than to rely on stereotyped formulae.

## ABDOMINAL INJURIES\*

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**A**BDOMINAL injuries caused by penetrating wounds or by contusion of the abdomen with resulting visceral damage are accompanied by a high mortality. In 1890 the mortality rate was about 90 per cent. This figure has gradually dropped until at present the rate for this type of injury throughout the United States is approximately 50 per cent. These patients are most frequently seen in industrial hospitals and in the large city hospitals. A group of seventy-one cases treated at Ancker Hospital in St. Paul were reviewed. This hospital has a large and very active emergency service. Despite the fact that

these patients are given immediate treatment and kept under constant observation it is startling to learn the high mortality encountered. What is the reason for this high mortality in an institution adequately equipped to care for such cases?

This group includes thirty-two patients who had received penetrating abdominal wounds, and thirty-nine patients who had abdominal contusions accompanied by visceral injury.

Twenty-eight of the patients with penetrating wounds were operated upon, four having been so badly injured that there was no possibility of giving any surgical relief. Fifteen of this group recovered and seventeen died, a mortality of about

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# ABDOMINAL INJURIES—JONES

TABLE I. ABDOMINAL INJURIES

Total number of cases	71
A. Penetrating wounds with visceral injury	32
Cases operated upon	28
Recovered	15
Died	17
Mortality	53.2%
B. Contused wounds with visceral injury	39
Cases operated upon	14
Recovered	7
Died after operation	7
Died without operation	25
Mortality	82.1%

TABLE II. PENETRATING WOUNDS

Gun shot wounds	27
Stab wounds	5
Cases operated upon	28
Not operated upon	4

Cases not operated upon, all gun shot wounds:

1. Died three hours after admission. Perforation of mesentery and kidney. Severe hemorrhage.
2. Died two hours after admission. Perforation of colon and jejunum. Severe hemorrhage.
3. Died seven hours after admission. Severe wounds of abdomen, chest and head.
4. Died four days after admission. Injury to lung, spleen, stomach, colon and small intestine.

TABLE III. PENETRATING WOUNDS OPERATION

DEATHS	
Died within six hours	4
Died within twelve hours	3
Died within twenty-four hours	3
Died after forty-eight hours	7
Died following operation	13

This group of patients had the following injuries:

Liver and duodenum	1
Small intestine	1
Small intestine and colon	3
Pancreas, duodenum and liver	1
Small intestine, iliac vein, severe hemorrhage	2
Stomach and small intestine	1
Colon	1
Small intestine and kidney	1
Liver and stomach	1
Colon and spleen	1

TABLE IV. PENETRATING WOUNDS. OPERATION

RECOVERIES	
Cases operated with recovery	
Injuries to liver	3
Small intestine, spleen—splenectomy	1
Small intestine	6
Colon and small intestine	1
Spleen and kidney—splenectomy	2
Stomach and duodenum	1
Stomach and transverse colon	1

53.2 per cent. A brief analysis of this group is shown in Tables I to IV.

It is interesting to note that the highest number of recoveries occurred in the patients in this group in whom the small intestine was the only abdominal viscus injured, and that only one of these died. Furthermore, all but two who died

TABLE V. CONTUSED WOUNDS OF THE ABDOMEN WITH VISCERAL INJURY

Seven patients recovered. All operated upon. This group had the following injuries:

Rupture of liver	1
Rupture of bladder	2
Rupture of small intestine	3
Rupture of spleen, splenectomy	1

Seven patients died following operation:

Died within six hours	3
Died within twelve hours	1
Died within twenty-four hours	1
Died after forty-eight hours	2

TABLE VI. CONTUSED WOUNDS. INJURIES

FOUND IN PATIENTS WHO DIED AFTER OPERATION

Rupture of liver	2
Rupture of spleen, splenectomy	3
Stomach, small intestine and colon	1
Ruptured bladder	1
Died without operation	25
Died within six hours	15
Died within twelve hours	2
Died within twenty-four hours	3
Died within forty-eight hours	5

TABLE VII. CONTUSED WOUNDS. INJURIES

FOUND IN NON-OPERATION DEATHS

Ruptured liver	11
Ruptured liver and spleen	3
Ruptured spleen	2
Rupture of small intestine and colon	1
Rupture of small intestine	2
Ruptured bladder	2
Rupture of kidney, spleen and liver	1
Rupture of kidney and liver	1
Retroperitoneal hemorrhage	1

Fourteen patients in this group had one or more complicating fractures.

had two or more structures injured, increasing the gravity of the problem and partially explaining the high mortality rate.

There were thirty-nine cases of contusion of the abdomen with visceral injury (Tables V to VII). Fourteen of these patients were operated upon with seven recoveries. Twenty-five died without operation and of this group fifteen died within six hours after admission. There were severe liver injuries in eleven instances in the non-operated group. Fourteen of these patients sustained one or more fractures in addition to the abdominal injury, again contributing to the appalling mortality rate. There is no question that many of the injuries we are called upon to treat today are more complicated and severe than those encountered before the advent of the high-speed motor car and the speed mania that has spread

over the country. Many of the automobile injuries are of the crushing type and there is often injury to the liver or spleen with or without injury to any other abdominal viscus. In this group of thirty-nine cases there was either a liver or a spleen injury alone or combined in twenty-six instances. This fact in itself explains a great deal of the high mortality rate in this group.

There are no cases included in this series of simple contusion or concussion of the abdomen. In this type of injury the patient is "knocked out" for a few minutes and recovery is prompt. However, in the more severe cases the picture is more complicated, presenting marked pallor, anxious expression, severe pain in the abdomen, labored, shallow respiration, thin, rapid pulse, low blood pressure, subnormal temperature, and frequently nausea and vomiting. Usually patients with simple contusion recover in a few hours from the state of shock. The picture of shock in these cases is similar to that found when visceral injury is present and it frequently is three or four hours before a positive diagnosis can be made. The shock is likely to be less profound and the recovery is usually more rapid. Because of the difficulty in differentiation, an occasional unnecessary abdominal exploration is carried out.

When there is contusion of the abdomen with visceral injury, the primary shock above described is present and with proper shock treatment, recovery occurs in three to four hours. At this point it is necessary to determine, if possible, the extent of the visceral injury. Very close observation of the patient is absolutely essential and every clinical sign must be carefully observed. In this way the early warning signs following the initial improvement will be detected. An increase in the pulse rate with a decrease in its volume is found in cases of marked hemorrhage. Muscular rigidity is frequently present and tenderness over the injured area may often be found. In injuries to the spleen a severe pain in the left shoulder, with painful respiration and restricted diaphragmatic movement on the left confirmed by x-ray, is of valuable diagnostic importance. If, after careful analysis of all the findings, it is determined that there is severe intra-abdominal bleeding, immediate exploration should be done. However, should the symptoms not indicate a severe hemorrhage there is no immediate operative emergency to deal with and expectant treatment may be followed.

One must, however, bear in mind that in spleen injuries there may be a delayed hemorrhage necessitating surgical treatment. A recent example of this was a young man who was playing basketball and was struck in the abdomen by the head of an opponent. He was able to finish the game but did not feel right. He consulted his physician and was allowed to return to work the next day. About ten days after the injury he was admitted to the Ancker Hospital. He presented the picture of severe intra-abdominal bleeding. His abdomen was explored and a spleen that weighed 760 grams was found fractured. The abdomen contained a great quantity of blood. A splenectomy was done. He developed post-operative pneumonia and after this subsided he was apparently making a good recovery. However, he again began running a high fever and a cause for the temperature was not found. He died about thirty days after admission. On autopsy many ulcerations were found in the intestines and eventually a diagnosis of typhoid fever was made. During the search for the cause of his temperature, a Widal test was made and reported negative.

It is very important to obtain an accurate history to determine if possible the degree of force and the direction of its application. When there is evidence of rupture of a hollow viscus, exploration must be performed as soon as the condition of the patient will permit. It has been shown that under these circumstances the mortality mounts greatly if this is not done within six hours after the injury.

The x-ray is a great aid in making a diagnosis of bowel or stomach perforation as free gas can often be observed under the diaphragm. Examination should be made with the patient in an erect position if possible, but if the patient is too ill he should lie on the right side, as a small amount of gas is more easily detected on the left side. Each case presents a different clinical problem and calls for the keenest clinical analysis by the surgeon. It is conceded that various clinical and laboratory methods are important but they do not replace keen clinical sense and interpretation. A recent experience was that of a man working with a motor-driven circular saw. A small piece of wood about four inches long and an inch wide flew from the saw and struck him in the abdomen. He had severe abdominal pain and was taken to a physician. The incident was treated light-

ly and he was sent home. His employer was not satisfied and wished further investigation. The patient, when admitted to the hospital, was having severe abdominal pain and had slight tenderness over the mid-abdomen. X-ray examination showed no free gas in the abdomen. In spite of this an exploration was done immediately and a laceration was found in the jejunum. This was sutured and the patient made a prompt recovery.

Injuries to the urinary bladder are frequently encountered, especially so in association with a fracture of the pelvis, and the repair should be done as soon as possible. Crushing injuries to the kidney are also common but do not often call for an emergency procedure as the injury is retroperitoneal and the compactness of the structure in this area aids in controlling the hemorrhage. An x-ray picture will sometimes show gas around the kidney and thus indicate rupture of the retroperitoneal portion of the duodenum or retroperitoneal portion of the colon.

Injuries to the gallbladder and bile ducts are not frequently encountered, but when present they must be cared for surgically. In pancreatic injury there may be a complete tear which sets free the pancreatic secretions, and pancreatic digestion and necrosis follow. Unless this damage is repaired and drainage established, the injury is usually fatal. There may be a less severe injury to the pancreas, resulting in the formation of a pancreatic cyst. Not infrequently mesenteric tears occur, resulting in severe hemorrhage demanding early surgical relief. Diaphragmatic hernia is another condition that must be considered in connection with contusion injuries to the abdomen. In a person receiving a severe blow to the abdomen a hernia through one of the diaphragmatic openings, usually the esophageal, may develop. When the abdominal injury is accompanied by a chest injury, there may be a rupture of the right or left hemi-diaphragm.

Bullet wounds or stab wounds of the abdomen may not injure any of the viscera, but if there is a perforating injury to a solid viscus, hemorrhage results, and peritonitis develops if there is perforation of a hollow viscus. Gunshot wounds are prone to give rise to tetanus, gas bacillus and other infections not only of the peritoneal cavity but of the abdominal wall. Unless one is positive that the wound has just grazed the abdominal wall without entering the peritoneal cavity, the abdomen should be explored immediately. Bullet

wounds may cause many perforations of the intestines and all the perforations must be closed. It has often been pointed out that in this type of injury there is an even number of perforations, and this is a valuable point to keep in mind. These openings are often very difficult to find. In discussing this point with Dr. John Noble, Pathologist at the Ancker Hospital, he commented on the number of cases that he has seen come to the autopsy table that have died of peritonitis because one intestinal perforation had been overlooked.

I realize the mortality rate of 53.2 per cent in the cases with penetrating abdominal injuries seems high, but it corresponds to other reports for similar cases. As pointed out previously, the highest number of recoveries occurred in the cases receiving only small bowel injury. The high mortality rate of 82.1 per cent in the group of contusions with visceral injury is explained by the severity of the abdominal injuries and also by the other severe injuries frequently sustained.

### Summary

1. Abdominal injury complicated by visceral damage is accompanied by a high mortality.
2. Constant observation of these cases is necessary until the extent of the injury is determined.
3. The treatment of shock is the first consideration in cases of abdominal injury.
4. Abdominal exploration should be carried out as soon as possible in cases of severe intra-abdominal hemorrhage and in penetrating wounds of the abdomen.

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### Discussion

DR. WM. C. BERNSTEIN: It has been a pleasure for me to listen to Dr. Jones' very clear and frank discussion of abdominal injuries. Drawing on my limited experience, compared to his, it would be difficult for me to add much of consequence to his paper. However, I would like to discuss several points.

Practicing as I do in rural Southern Minnesota, I am often impressed with the large number of these major abdominal injuries which occur outside the industrial centers. Farm implements and farm animals account for a large number of these accidents but the ever increasing automobile hazard on the highways where strict traffic regulations are not enforced as they are in the cities furnish a great many cases of abdominal injuries. Gun-shot wounds of the abdomen during the hunting season are also becoming quite common. For this reason most small hospitals in rural Minnesota have become equipped to handle these cases as well as they are handled in any larger center. I say this without fear of contradiction.

Dr. Jones has stressed the point that close and undivided attention must be given to these patients during the first hours to determine whether the shock is due to the so-called "abdominal concussion" or to actual visceral damage. This brings up the question of blood transfusion in these cases. So often, we hear of large amounts of blood or other fluids being given

to a patient for his hemorrhage where, in fact, the fluid is running out of his torn vessel as fast as it is being introduced into the vein. Many patients would be better benefited if the abdomen were opened, the bleeding vessels tied off, and the introduction of blood or other fluids then started. We must not forget that raising the blood pressure can easily start a vessel bleeding once more.

Finally, I would like to emphasize the point that many a patient's life has been saved by the good judgment of the surgeon in deferring operation. This is especially true in cases of retroperitoneal injury, including rupture of the kidney. Dr. Jones has mentioned the fact that due to the compactness of the structures, hemorrhage here often takes care of itself. I recall one case in point where a man had a ruptured kidney and was brought in in extreme shock. There is no question but what he would have died if we had operated on him. We treated him expectantly and when he was in good shape for operation he refused and has now worked hard for five years without an operation.

## **INTRACTABLE LOW BACK AND SCIATIC PAIN DUE TO PROTRUDED INTERVERTEBRAL DISKS: DIAGNOSIS AND TREATMENT\***

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THE intervertebral disks act as shock absorbers; they probably were the first hydraulic shock absorbers invented. When one of these disks becomes injured and a portion of it protrudes, the patient may complain of backache or sciatic pain. For years, such patients have received the most varied treatment. The treatment in many cases has run the gamut of pharmacologic, orthopedic and physical therapeutic measures. Manipulations and adjustments by irregular practitioners likewise have been given credit for the relief and, in some cases, even for semimiraculous cures of some of these partially or wholly disabled individuals.

The more or less general use of roentgenography in studying the vertebral columns and sacro-iliac synchondroses of individuals whose chief complaints were backache and sciatica did much to clarify thinking concerning painful conditions of the spinal column. The condition known in the earlier literature as "railway spine" practically disappeared. Physicians and even laymen began to feel that if roentgenograms of the vertebral column gave evidence of a normal condition and no evidence of fracture, there could be no gross change in the skeleton to ac-

count for the pains in the back and legs. During the past few years tremendous progress has been made in diagnosis and treatment of many heretofore obscure painful conditions.

It is not my desire to increase the number of already alarmingly high industrial hazards nor to cause men and women to seek compensation that is not their just dessert. It is my desire only to call attention once again to a very common cause of partial or complete chronic invalidism. This cause is notorious for the paucity of objective findings in the course of the usual physical examination. Ordinary roentgenography, likewise, fails in the vast majority of cases to give a clue to the real pathologic condition which underlies the patient's disability.

Although lesions of the intervertebral disks as a cause of intractable sciatic pain have been recognized for many years and Adson, at The Mayo Clinic, in 1922, cured a dentist of intractable sciatica by removing a protrusion of a lumbar disk, it has only been within the last few years that a more general appreciation of the rôle of the intervertebral disks in the causation of compression of the spinal cord and nerve roots, with subsequent development of painful syndromes, has come about.<sup>5</sup>

Prior to the realization of the frequency with which intervertebral disks may be protruded and

\*From the Section on Neurologic Surgery, The Mayo Clinic, Rochester, Minnesota. Read before the meeting of the Minnesota State Medical Association, Duluth, Minnesota, June 29 to July 1, 1938.



be the cause of low back and sciatic pain, laminectomy for removal of such cartilaginous protrusions was infrequent. Today, laminectomy for removal of protruded disks is one of the commonest of neurosurgical operations performed at The Mayo Clinic.

A clear understanding of the nature of the normal intervertebral disk and of its relationship to the two adjoining vertebral bodies, to the posterior longitudinal ligament, to the intervertebral foramina and to the spinal cord and nerve roots is essential to full appreciation of the rôle which the cartilaginous intervertebral disk plays in the production of chronic continuous or of intermittent and recurring low back and sciatic pain.

The intervertebral disk is composed of two parts: (1) the annulus fibrosus, a rather dense, elastic fibrocartilage, which is intimately attached to the margins of the adjoining vertebral bodies; (2) the nucleus pulposus, a very soft resilient tissue which is enclosed, and in the normal state is maintained by the annulus fibrosus. Normally, the posterior longitudinal ligament, which extends from the second cervical vertebra to the sacrum, and thus forms a part of the anterior wall of the spinal canal, aids in the maintenance of the intervertebral disk within its position. The spinal cord, surrounded by its meninges, lies directly posterior to the posterior longitudinal ligament and the paired spinal nerves emerge from the dural sac and leave the spinal canal at the intervertebral foramina. A more detailed study of the spinal nerves and their relationship to the intervertebral spaces is necessary for a clear understanding of the way in which a particular protruded disk may involve a given nerve root. The fact that the spinal nerves do not come off at right angles and do not immediately leave the spinal canal opens the possibility of considerable variation occurring in the impingement of some of the disks on the nerve roots.

Intervertebral disks occur throughout the spinal column from the space between the second and third cervical vertebrae to the coccyx. Those present in the fixed vertebral segments (sacrum and coccyx) are rudimentary, however, and rarely, if ever, are protruded with the resultant production of low back and sciatic pain.

As far as is known, any of the others may be protruded, although there are certain disks which seem particularly vulnerable.<sup>6</sup> At the clinic we

have encountered several protrusions in the cervical and thoracic regions of the spinal column, but by far the largest number of protrusions encountered have been in the lumbar region.

### Etiology and Pathology of Protruded Intervertebral Disk

The nucleus pulposus consists of a semisolid substance and when stress or strain is applied to the back the nucleus pulposus may be forced against the elastic annulus fibrosus and cause considerable stretching of this latter structure. When the stress is ended, normally the disk returns to its usual position. When unusual stress or strain is applied to the back the annulus fibrosus may be injured and then a portion of the disk escapes from its normal position between the vertebrae. The portion of the disk which escapes or protrudes may consist of a pea-sized fragment of fibrocartilage, or it may be several centimeters in length and breadth (Fig. 1). The majority of the protrusions, however, are small and their ability to produce symptoms depends on their relationship to nerve roots.

It is my feeling that true protrusions of intervertebral disks are a result of undue stress or strain placed on the fibrocartilaginous annulus fibrosus. The stress may be secondary to the lifting of a heavy object,<sup>2</sup> the cranking of a tractor, forceful unexpected sitting (such as on a slippery pavement) or to a blow on the back. Whether there is one or more than one predisposing cause which makes one individual more susceptible to this lesion than another I am unprepared to say. It is true that many of our patients at the clinic have had congenital anomalies of the spinal column, particularly in the region of the lumbosacral joint. These anomalies have consisted of the presence of four or six lumbar vertebrae instead of the usual five; partial or complete sacralization of the last lumbar vertebra; partial or complete lumbarization of the first sacral vertebra; incomplete fusion of the laminae posteriorly, with the occurrence of spina bifida occulta and of anomalies of position of the articular facets, particularly of those of the fifth lumbar and first sacral vertebrae. About 25 per cent of our patients have been unable to recall an injury to the back even after a protruded disk has been removed.<sup>7</sup>

The cartilage which protrudes into the spinal canal and encroaches on the spinal cord or on one

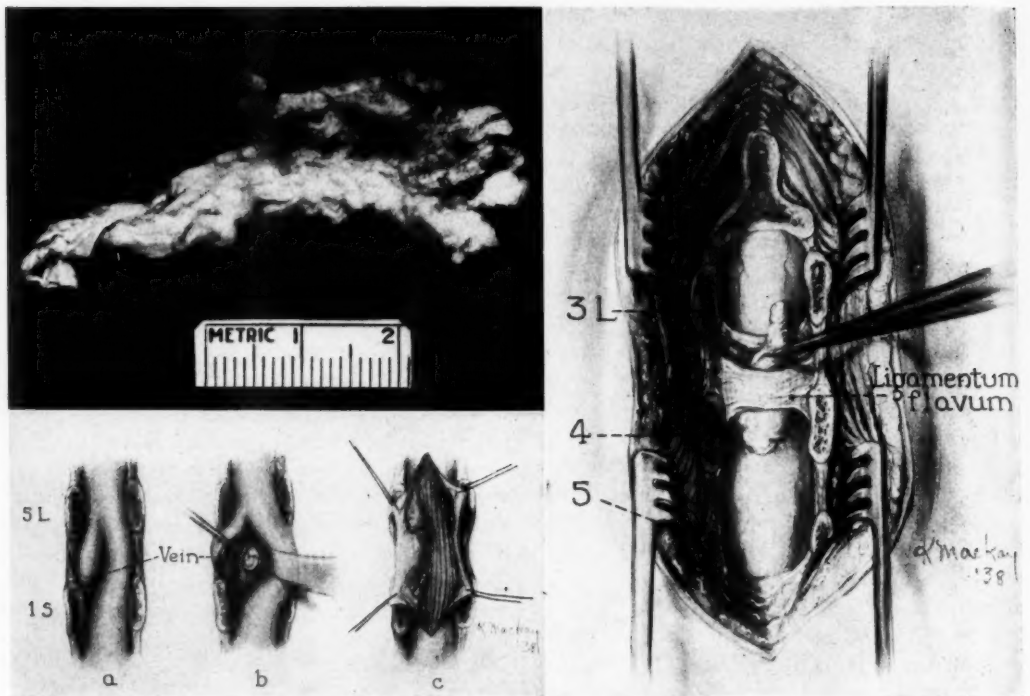


Fig. 1 (upper left). Protruded portion of lumbosacral disk removed at operation in a case in which backache and sciatica had endured for one year. Complete relief was obtained following removal of the protruded portion.

Fig. 2 (right). In this case a portion of a protruded disk had perforated an hypertrophied ligamentum flavum.

Fig. 3 (lower left). The findings at operation in a case in which backache and left sciatic pain had endured for twelve years. a, the characteristic enlargement of the nerve root; b, the thinned out posterior longitudinal ligament has been incised and the protruded portion of the disk is escaping; c, enlargement of the intradural portion of the fifth lumbar and first sacral nerve roots on the left. The remainder of the cauda equina is normal.

or more nerve roots may be small or relatively large, as large as a section of the cord itself. So far as I know, however, the entire disk never protrudes and since surgical treatment of this condition consists in removal of the protruded portion of the disk, the entire disk is never removed. Some of the protruded portions are so small that they may be overlooked on superficial examination of the intervertebral space. Some, however, are so large that they obstruct the spinal canal and appear and feel as if they were large, intraspinal neoplasms. At times the disk is so completely fragmented that loose fragments of cartilage may be found lying on the dorsal aspect of the dural sac. In one case, a piece of disk tissue was found, having perforated a ligamentum flavum (Fig. 2). In the majority of cases, however, the findings are similar and characteristic. The majority of the protrusions occur laterally (the central part of the posterior longitudinal ligament is strongest and there are defi-

ciencies laterally) and thus the unilaterality of symptoms and signs is explained. The nerve root compressed by the protruded disk is always enlarged owing to injection and edema secondary to the compression (Fig. 3). The enlarged nerve root is usually elevated and appears more posterior than does its fellow of the opposite side. At times the enlarged nerve root is displaced mesially or laterally by the protruded disk. The variations of the relationship of the protrusion to the nerve root cause minor variations in the technic of removal of the protruded portion. Ordinarily the protrusion appears as a smooth, rounded or dome-shaped tumefaction, the resilience of which is easily tested when slight pressure is applied to it with an instrument. Occasionally, when the involved nerve root is retracted, one or more loose fragments of cartilage will pop out free into the canal and they are lifted from the wound with forceps. The usual condition, however, requires incision of the "cap-

sule" which allows the bulging cartilaginous fragments to escape. The capsule is a thinned portion of the posterior longitudinal ligament. The fragments unwind, as it were (Fig. 3b), as they

cord by an intraspinal neoplasm. If the protrusion into the spinal canal occurs laterally, as it most often does, then the early symptoms are those of irritation of a nerve root and, later,

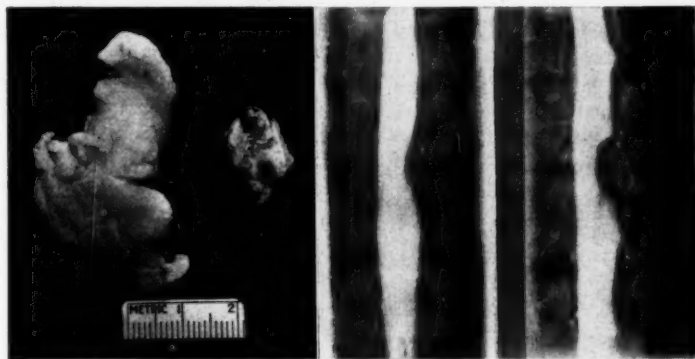


Fig. 4 (left). Protruded portion of fourth lumbar disk which had produced paraplegia and complete subarachnoid block. The smaller specimen represents the hypertrophied overlying ligamentum flavum.

Fig. 5 (right). Postero-anterior and antero-posterior roentgenograms which demonstrate a defect in the column of lipiodol opposite the eleventh thoracic intervertebral space. The patient had had backache without sciatica for ten years. At operation an hypertrophied ligamentum flavum was resected and a protruded portion of the eleventh thoracic intervertebral disk was removed. The patient has been relieved of his backache.

escape through the incision in the ligament, and they appear much like ragged pieces of tendon which have been matted together in a small ball. The protrusions vary in consistency from that of soft mucoid material to the bony hardness of complete ossification.

Microscopically, various degrees of degeneration are noted. There may be simple edema or there may be various stages of hyaline degeneration, calcification or ossification. The tissue contains both nuclear and annular material<sup>1</sup> and it is for that reason that we prefer to designate the lesion by the term "protruded disk" rather than "herniated nucleus pulposus," "rupture of the intervertebral disk," or any of the other terms used in connection with injury and extrusion of the intervertebral fibrocartilage. True neoplasms of the disks occur, but that is another subject and is not to be considered in this paper.

### Symptoms and Diagnosis

The symptoms produced by protrusion of an intervertebral disk vary according to the disk involved and the site at which the protrusion occurs in relation to the particular disk. If the protrusion occurs in the midline in the cervical or thoracic region of the spinal canal the symptoms are likely to be those of compression of the spinal

those of interruption of the impulses that travel along that nerve, owing to severe compression. Large protrusions in the lumbar region may give all the symptoms and signs of an intraspinal neoplasm and produce paraplegia by compressing the cauda equina and interrupting all nerve function below the level of the lesion (Fig. 4).

Of all the protrusions of disks for which we have performed laminectomy (more than 200) about 90 per cent have occurred in the lumbar region and the most common symptom has been sciatic pain.<sup>3</sup> The pain in the course of the sciatic nerve, on one side or, more rarely, both sides, may be and usually is associated with more or less pain in the lower part of the back. The low back pain is situated in the lumbar region, lumbosacral region, over the sacro-iliac synchondroses, or it may exist chiefly in the buttocks. A small percentage of patients have had low back pain without projection of the pain along sciatic nerves. When low back pain exists for a considerable period without projection along one or both sciatic nerves, the protrusion is more likely to be in the lower thoracic region than in the lumbar region (Fig. 5).

The patient who has a protruded intervertebral disk usually gives a history of trauma to the spinal column. However, about a fourth of the

patients are unable to recall any distinct injury.

The pain of which these patients complain partakes of the usual characteristics of root pain. That is, the pain follows the anatomic distribution of the peripheral nerve which has its origin in the nerve root involved. The pain is usually aggravated by coughing, sneezing and straining, or by anything that increases the pressure of the spinal fluid. Some of the patients state that they are unable to sleep at night because of exacerbation of their symptoms in the small hours. Others state that they are comfortable while recumbent.

If the lesion has been present for a long time, is large, or there have been repeated exacerbations of symptoms, weakness and numbness of the involved member may constitute a major complaint.

One of the most important points in the history of a patient who has a protruded disk is the fact that, in spite of treatment by the long accepted methods, the symptoms have persisted. When low back or sciatic pain fails to respond to the usual conservative orthopedic measures a protruded disk as the causative factor should be considered.

On examination, the patients frequently exhibit scoliosis and they move about cautiously in order to prevent jarring and thus exaggeration of their pain. When sitting down or rising from a sitting position they guard their motions. When a considerable number of these patients have been seen the diagnosis in a given case can be surmised after observing the patient rise from a sitting position and walk across a room. The posture and gait are often characteristic.

When the patient is disrobed and examined one notes, in addition to the scoliosis, spasm of the erector spinæ muscles. Raising of the straight leg produces severe pain, and motion of the involved lower extremity, as well as of the spinal column, is limited.

The neurologic findings vary considerably. In the presence of larger lesions definite paralysis exists. There may be more or less complete paralysis of both lower extremities. The vesical and anal sphincters likewise may be paralyzed. The majority of the patients, however, display few objective neurologic findings. The most constant finding is diminution or absence of the Achilles tendon reflex on the involved side. There may be or may not be sensory loss and tenderness along the course of the involved nerve.

The roentgenographic findings are not specific for protruded intervertebral disk. All patients should be subjected to careful roentgenologic studies in order to exclude other conditions which might account for their symptoms. Particularly, tuberculosis and malignancy of the vertebræ should be excluded.

The spinal fluid should be examined in all cases of intractable low back and sciatic pain. The most important finding in cases of protruded intervertebral disk is elevation of the concentration of total protein. In about 75 per cent of cases the total protein of the spinal fluid will be more than 40 mg. per 100 c.c. Discovery of subarachnoid block on lumbar puncture is rare, but when it exists extensive paralysis is usually present also. In the presence of subarachnoid block a diagnosis of intraspinal neoplasm usually is made. If lesions are caudal the reversed Queckenstedt test is positive.<sup>2</sup>

Although the diagnosis of protruded intervertebral disk can be, and often is, made on the basis of the history and physical findings, it is at present essential in the majority of cases that the diagnosis be confirmed before advising operation for removal of the protruded portion of the disk.

The diagnosis can be confirmed in most cases by fluoroscopic examination of the spinal canal after subarachnoid injection of an opaque material. The opaque material which we are using is 40 per cent iodine in poppy seed oil (lipiodol). Five cubic centimeters of this substance are injected through a spinal puncture needle into the lumbar subarachnoid space. Careful fluoroscopic observation of the movements of the oil while the patient is being tilted on a tilting fluoroscopic table is essential to detect the smaller lesions.

A word of advice regarding introduction of the lipiodol may be worth while. It never should be used in the presence of a suspected inflammatory lesion. It never should be introduced at a temperature above that of the body. It should not be used if it is cloudy. In cases in which a lesion of a disk is suspected, it is my practice to inject the lipiodol through the second or third lumbar interspace, since about 90 per cent of the lumbar protrusions occur at the fourth or fifth interspace. Introduction of the lipiodol at the level of the protrusion is at times painful and there is an increased chance, because of distortion of the dural sac, of the lipiodol spreading



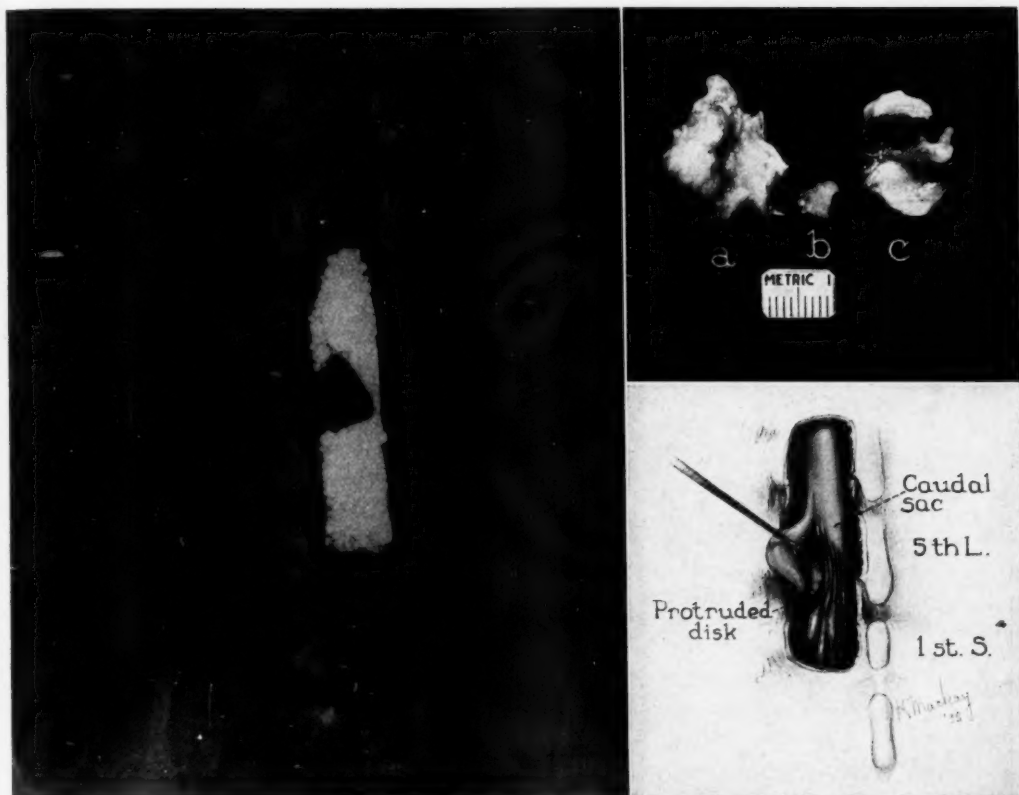


Fig. 6 (left). Postero-anterior roentgenogram showing defect in the column of lipiodol opposite the third lumbar intervertebral space on the left. This defect is characteristic of protruded intervertebral disks. The patient had sustained an injury of his back a year and a half previously and had suffered backache and left sciatic pain since.

Fig. 7 (upper right). Specimens, removal of which relieved a man of chronic backache and sciatica of one year's duration. a, protruded portion of fifth lumbar disk; b, corresponding portion of the ligamentum flavum between the sixth lumbar and first sacral vertebrae. This ligament was not abnormal. There were, in this case, six lumbar vertebrae; c, the ligamentum flavum between the fifth and sixth lumbar vertebrae. The ligament was markedly thickened.

Fig. 8 (lower right). Exposure, by means of hemilaminectomy, of a protruded lumbosacral disk. The patient had had backache and left sciatic pain for fifteen years. The study with lipiodol was negative because the caudal sac ended above the level of the protrusion.

extradurally. The defect produced in the column of lipiodol by a protruded intervertebral disk usually is characteristic (Fig. 6). The defect usually is anterolateral in position and is situated opposite the intervertebral space. In addition to the defect produced by the disk itself, often a defect owing to the enlarged, edematous, involved nerve root can be detected in the shadow of the lipiodol. Recently we have come to recognize defects attributable to hypertrophy of the ligamentum flavum. This abnormality of the overlying ligament is, I feel, a more or less constant accompaniment of protrusion of an intervertebral disk (Fig. 7). There are, however, cases in which hypertrophy of the ligamentum flavum causes low back and sciatic pain without

associated protrusion of a disk. This condition, occurring as a single lesion, however, in our experience, is much less common than is hypertrophy of the ligament associated with true protrusion of the underlying disk. In every case careful search should be made to exclude an associated lesion of a disk.

As our experience has increased, on a few occasions we have advised laminectomy for protruded disk in the face of negative examination with lipiodol. Whenever this is done the patient should be advised of the possibilities and the operation should not be performed until every other condition which might account for the patient's symptoms is excluded.

Occasionally a patient will be encountered in

examination of whom a positive test is impossible for anatomic reasons. The caudal sac may end above the lumbosacral space and thus the lipiodol cannot reach the level of protrusion (Fig. 8).

### Treatment

There is only one treatment for protrusion of an intervertebral disk that is producing compression of the spinal cord or of a nerve root. When a definite protrusion is demonstrated and a lesion at the level of the protrusion will explain the patient's symptoms and signs, laminectomy for the express purpose of removing the protruded portion of the disk should be performed. Anyone who has witnessed the operative removal of a protruded disk and seen the relationship of the abnormal cartilaginous mass to the spinal cord or nerve root, the edema, the enlargement and displacement of the nerve root and the complete relief of pressure following removal of the protruded portion will agree, I feel sure, that there is a definite anatomic and pathologic basis for the condition under discussion (Fig. 3). If there still should be any doubt, to see the patient when he leaves the hospital two weeks later, free of pain, free of scoliosis and smiling is sufficient to convince even the most skeptical.

In performing laminectomy for protruded intervertebral disk, removal of two spinous processes and of two pairs of laminae is, in the majority of cases, sufficient to obtain adequate exposure. The articular facets should be preserved. Resection of the ligamentum flavum, which is found to be hypertrophied in most, if not in all cases, aids materially in obtaining satisfactory exposure of the involved nerve root and the underlying protruded part. Since most of the protrusions are lateral to the common dural sac, most of them can be removed extradurally before the dural sac is opened. Leaving the dural sac intact serves three distinct purposes: there is less bleeding from the extradural vessels while the hydrostatic effect of the cerebrospinal fluid is active; the cerebrospinal fluid acts as a buffer to protect the cauda equina while the dura mater is being retracted, and finally if one should be unfortunate enough to encounter a previously unrecognized extradural inflammatory lesion, the subarachnoid space and its contents would be protected from contamination.

After the protruded portion of the disk has been removed the dural sac is opened and the

interior inspected. Edema of the intradural portion of the involved nerve root is noted (Fig. 3c). The canal is carefully inspected to be sure that all pressure has been removed. The lipiodol is sucked out before the dura mater is closed. Bone graft or fusion is not necessary.

Following operation the patients are kept in bed for twelve days. They are allowed to leave the hospital on the fourteenth day and to return to their homes three weeks after operation. They are advised to refrain from heavy lifting or from placing stress or strain on their backs for three months. After this time they are encouraged to return gradually to their former activities. The period of hospitalization and period of convalescence is much shorter than it would be if bone grafting were performed. This is, of course, a tremendous saving in expense to the patient and he is enabled to return to work much sooner. The hypertrophied ligamentum flavum is resected in the course of exposing the protrusion.

### Results

Our results justify continuation of our present treatment, namely, laminectomy and removal of the protruded portion of the disk. Most of the patients are completely relieved of their symptoms and are able to return to their former occupations. There has been one postoperative death in more than 200 laminectomies for protruded intervertebral disk. There has been one recurrence. This patient was completely relieved following a second operation.<sup>4</sup>

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### Discussion

DR. HAROLD O. PETERSON, Minneapolis: I am sure that Dr. Love and his associates have had more experience with posterior protrusion of the intervertebral disc than any other person or group, and I heartily agree with everything he has said. Since my experience has been limited largely to the roentgen diagnosis of this condition I shall confine my remarks to this phase of the subject.

I was gratified to hear that Dr. Love is still as en-

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thusiastic about the diagnosis and treatment of this condition as he was when the original reports were made. Although it is several years now since the first papers were published and even though the condition is known to exist by many it is still difficult in some places to obtain a satisfactory examination in order to establish the diagnosis. By a satisfactory examination is meant the injection of lipiodol into the spinal canal in sufficient quantities (5 c.c.) to permit a thorough radiographic examination.

This is due entirely to the fear of injecting a foreign substance such as lipiodol into the subarachnoid space. In a review of the literature one year ago I was able to find only a few isolated instances in which it was probable that permanent damage had followed its use. Those who had used lipiodol the most reported no serious consequences, although many patients had temporary ill effects which disappeared after the second or third day. Therefore, although there may be an occasional case which shows undesirable cord and nerve root damage subsequent to lipiodol injection, the information which can be obtained only by this method outweighs the danger of any possible ill effects.

The indiscriminate intraspinal injection of lipiodol into every patient with a backache is, however, not justified and it is for this reason that a thorough orthopedic and neurologic examination is necessary in every case to exclude all other possible explanations of the pain. Dr. Love has adequately outlined the indications for lipiodol study, and I merely wish to emphasize a few points. Lipiodol study of the spine should be reserved for those cases of chronic back pain which have failed to respond

to conservative treatment and is contra-indicated in those patients with acute back pain of short duration. Ordinary roentgenograms must be taken of the spine before lipiodol injection is considered. I recall one case in which a diagnosis of metastatic malignancy was readily made on the films taken after lipiodol injection, there having been no previous films made. It should be understood, however, that a positive diagnosis of herniated disc cannot be made from the plain roentgenograms alone. Suggestive findings may be present in at least half of the cases consisting of narrowing of the intervertebral disc, straightening of the normal lumbar lordosis, and scoliosis.

The lesion which Dr. Love has described explains on a sound anatomic and pathologic basis many of the cases which have been heretofore loosely and incorrectly diagnosed as sciatica or sacro-iliac disease. It is difficult to understand how sacro-iliac disease, per se, can ever produce sciatic pain. It must be remembered, however, that all cases of low back pain, even if sciatic radiation is present, are not due to herniated discs. Since these cases are clinically indistinguishable in many instances from what is usually called sacro-iliac disease, sciatica and low back strain, it is essential that a lipiodol study be made. By this method of examination 90 to 95% of the cases can be correctly diagnosed and localized.

In closing I should like to emphasize the necessity of thinking of this condition in those patients who have intractable low back pain and especially where there is sciatic radiation. If the usual methods of treatment fail, lipiodol injection is indicated.

## THE VALUE OF THE X-RAY IN GENERAL PRACTICE\*

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Rochester, Minnesota

EARLY in the eighteenth century, a French physicist of peasant birth spent many hours on research concerning the passage of an electric current through a tube from which the air had been evacuated. A curious void contrivance which he constructed at that time and which not inappropriately was called the "electric egg" undoubtedly represented the earliest and humblest ancestor of the modern vacuum tube.

Nearly eighty years passed before further activities in this field of scientific research were initiated. The new light which Wilhelm Conrad Roentgen discovered, in 1895, was actually produced in 1785 and many times after that, but it was not recognized until the discovery by Roentgen. Roentgen gave the new light the name of "x-ray"; in his honor it was later called the "roentgen ray" and the new science which developed from his discovery was given the name of roentgenology.

The possibilities of the x-rays as a diagnostic agent in medicine were discussed before the Berlin Medical Society the day previous to, and before the Society of Internal Medicine in Berlin the day of the announcement of the discovery. By the end of February, 1896, the method was in comparatively general use as a new diagnostic procedure in many countries.

The epochal feature of the roentgen rays was that they supplemented conjecture in medicine with visual and graphic factual evidence. Because of technical difficulties, it was many years before the application of the method became practical in routine investigation. The World War was probably a real factor in stimulating interest in this new field of investigation. The demand for machinery and accessories necessary to the production of roentgenograms and the visualization of various anatomic parts fired the imagination of the industrialist and encouraged the expenditure of time and money in research which resulted in the production of the paraphernalia required.

\*From the Section on Roentgenology, The Mayo Clinic, Rochester, Minnesota. Read before the annual meeting of the Minnesota State Medical Association, Duluth, Minnesota, June 29, 1938.

Concomitant with this industrial research went the correlation of roentgenologic findings and the already known facts of clinical and pathologic investigation. The pioneers in this work established new foundations in the appearance of normal structures and the normal limit of their variations. They proved that the roentgenographic image was a reproduction in relief of the various components of the body, normal and abnormal. They found that the idiosyncrasies of individual disease entities, expressed in predilection for certain types of tissue and definite situation in particular structures, long known to the pathologist, could be graphically recorded. In short, they discovered that roentgenology afforded the opportunity to study pathologic changes in the living patient. Experience with the new method revealed a new and unique advantage: by serial roentgenography it was possible to study the changes resulting from the progression or regression of the individual morbid process and thereby evaluate specific forms of therapy and at the same time more accurately establish the prognosis.

Radiotherapy has become a definite factor in the establishment, or in the corroboration, of a diagnosis. For example, the changes produced by radiotherapy in Ewing's tumor are characteristic enough to be diagnostic.

With the aid of substances ingested or injected or autogenously produced after the injection or ingestion of chemical compounds, most of the viscera of the body were rendered visible in roentgenoscopic observation or in the roentgenogram. Other viscera were made visible by the introduction of air or gases. The anatomist, the physiologist, and the pathologist, working with the aid of roentgenography and roentgenoscopy, have added materially to the sum of knowledge of their special subjects.

The value of the roentgen rays in general practice is familiar to most of you; time will only permit discussion of a single phase of the subject, the use of the method in the diagnosis of lesions involving bone.

Let me sound a note of warning. The interpretation of roentgenologic findings is not to be undertaken lightly. It involves a serious responsibility. An error in conclusion may influence subsequent therapy to an extent that might be embarrassing and even disastrous to the interests of the patient and to professional reputation.

To avoid such disaster, one must have some knowledge of the fundamental changes in the architecture of bone peculiar to certain diseases. This point can best be illustrated by considering the salient features of the benign and malignant neoplasm of bone. The decision of paramount importance that one may be called on to make is whether a given lesion involving bone is inflammatory or neoplastic, and, more important still, if neoplastic, is it benign or malignant in nature. Of lesser importance, but still very helpful in later consideration, is whether the lesion is a primary neoplastic one or whether it is a secondary (metastatic) implant in bone from a malignant tumor in some remote part.

The importance of this statement lies in the fact that not infrequently in a case in which the lesion has been considered comparatively innocuous the roentgenogram reveals a primary malignant tumor or metastatic involvement. The metastatic involvement may be the first indication of a malignant lesion in the body and may institute a search for the primary neoplasm.

To lessen the confusion resulting from any elaborate attempts at classification, this discussion will be limited to the main groups of lesions recognized by the committee of the Clinical Pathological Association and their simulants. To enable consideration in sequence I have rearranged this classification as follows: (1) benign osteogenic tumors, (2) periosteal fibrosarcoma (extraperiosteal sarcoma), (3) noninflammatory conditions simulating benign lesions of bone, (4) giant cell tumor, (5) benign angioma, (6) myeloma, (7) malignant osteogenic tumors, (8) inflammatory conditions simulating malignant lesions of bone, (9) Ewing's tumor (Ewing's sarcoma), (10) malignant angioma, and (11) metastatic involvement.

### Benign Osteogenic Tumors

The word "osteogenic" is used here, not in the sense of bone forming, but simply to designate a tumor arising from bone cells or bone-forming cells in contradistinction to tumors that originate in bone marrow cells or in the vessels of bone or bone marrow. The outstanding roentgenographic feature of a benign tumor of bone is the retention of the cortical contour. The cortex may be expanded or otherwise deformed but there is never any dissolution of its continuity. On the other hand, the almost pathognomonic



characteristic of the malignant osteogenic tumor is the definite break in the continuity of the cortical outline. This, with but few exceptions, which will be mentioned, is the prominent feature of malignant tumors of bone.

Turning to the pathology of these lesions, one finds that these features have been described. In 1925 Broders said: "The chief difference between the average benign neoplasm and the average malignant one is that the benign exerts more control over itself than the malignant. It cannot be said that any neoplasm has complete control of itself at all times, because the very fact that it grows shows that its control is not absolute, but, fortunately for the human race, the majority of neoplasms do reach a point of absolute self control, or, in other words, obey the law of limitation of growth. . . . Benign neoplasms produce a structure in which the cells are practically indistinguishable from the cells of normal tissues, although the arrangement is somewhat different, and unquestionably a number of benign neoplasms function to some extent like the tissues they so closely imitate . . . All benign neoplasms, like the tissues which they imitate, produce regenerative cells as well as differentiated cells; otherwise they could not grow, because the differentiated cells do not reproduce. It is also reasonable to believe that the regenerative cells of benign neoplasms are more active than the regenerative cells of normal tissues, and that the regenerative cells of certain benign neoplasms are more active than the regenerative cells of others, because they grow faster than others. It may be that the regenerative cells of benign neoplasms are more numerous than those of others."

"When benign neoplasms reach the point of complete self control, their cells either cease to regenerate or they differentiate beyond the point of regeneration. If all the cells of a benign neoplasm have differentiated beyond the point of regeneration, there is only one thing for the neoplasm to do, and that is to degenerate, and this probably often takes place, especially in myomas of the uterus. Degeneration seems to be one of Nature's methods of getting rid of neoplasms . . . In passing from benign to malignant neoplasia, the fact should not be lost sight of that the power of self control still exists, although to a gradually diminishing degree. A wart that has been slowly growing for a number

of years may show evidence of increased rate of growth, and after it has been excised and examined under the microscope, cells are observed at its base that differ from those found at the base of the ordinary benign wart . . . The regenerative cells at the base of this wart have undergone . . . anaplasia (undifferentiation), or a process of dedifferentiation . . . These anaplastic or dedifferentiated cells appear to represent a new type, and are observed in all forms of malignant neoplasia, although they vary in shape and size in different types of malignant neoplasms . . . These anaplastic or dedifferentiated cells have various potentialities . . . I wish to emphasize here a good potentiality, or the power to produce cells that differentiate or reach a state of maturity beyond their ability to reproduce. This differentiating or controlling quality ranges from practically nothing to almost 100 per cent. The cells of a neoplasm that show practically no tendency to control themselves rapidly infiltrate the adjacent structures and, by utilizing the vascular system as a means of metastasis, set up colonies in various parts of the body, which in turn keep on producing their own kind of cells, finally with a fatal result. On the other hand, if the cells of a neoplasm show a marked tendency to control themselves by differentiation the neoplasm will grow slowly, and show very little tendency to metastasize; or if some of the cells do metastasize, they will in turn set aside the large majority to differentiate and build a structure similar to that found in a normal organ, which functions to some extent. . . .

"Malignant neoplasms need not necessarily be preceded by benign neoplasms; the large majority are not. Many are preceded by destruction of tissue, but others spring up without the slightest injury, so far as we know . . . It would seem that this type can only be explained by heredity. These should be called true spontaneous neoplasms."

When one studies the so-called benign tumors of bone it immediately becomes apparent that the majority of them at least, if not all of them, occur in early life and at about the age of puberty. Most of them are situated at the growing ends of bone and in many cases there is a distinct tendency toward cessation of growth and even regression at about the period when the development of the skeleton is complete. All of these facts point to a disturbance in develop-

ment of the cartilaginous elements in the formation of bone and joints. It may be difficult in some cases to draw the line between the abnormal and the normal state. For example, limited outgrowths of preëxisting cartilage occurring in the ribs and about the joints are distinguished as *enchondroses*. True progressive neoplasms which are composed of cartilage appear in the same situations and also in tissues which normally do not contain cartilage; these neoplasms are called *enchondromas* or *chondromas*. Chondromas are familiar to most of us as single or multiple tumors of the hands and feet. In some chondromas the formation of cartilaginous matrix is imperfect and a simple hyaline material results. Roentgenographically such a tumor is transparent to the roentgen rays; it will only cast a shadow by virtue of its bulk. In cases of smaller tumors the only evidence in the roentgenogram may be a filling defect in the bone, which has a smooth margin; this is the result of erosion of the tumor by pressure. Calcification with the deposit of phosphate and carbonate of lime may cause incrustation of both the matrix and the cells and may produce a characteristic roentgenographic image. The tumor may be partly fibrillated and be recognizable as a fibroma. Mucinous material may take the place of the matrix; in such cases the prefix *myxo* is used in the pathologic nomenclature. Ossification of chondromas occurs; depending on the preponderance of bone or cartilage, the tumor is known as an *osteoma* or *osteochondroma*. These subdivisions of this group of tumors can all be recognized by their roentgenographic images.

The *exostosis* occurs in two forms: (1) the single outgrowth of bone which is capped by a cauliflower shaped excrescence of cartilage, and (2) the multiple symmetrically distributed lesions of the same type, which are familiar to most of us as multiple congenital *exostoses* or hereditary *deforming chondrodysplasia*. If one accepts Keith's explanation of the occurrence of the latter type, that is, a congenital defect in the periosteum which normally acts as a *ferule* in the control of the architecture of bone, and if one accepts the opinion that benign tumors of bone are due to a disturbance in development of the cartilaginous elements in the formation of bone, then all the lesions which have been mentioned are in the same category. Their roentgenographic images confirm this opinion. The con-

trol stressed by Broders is perfectly apparent in the roentgenogram. In the benign osteogenic tumor the contiguous soft tissue structures are only invaded by the expansion of the cortex of the bone.

In the malignant osteogenic tumor, the tumor breaks through the cortex and "promiscuously" invades the surrounding soft tissue structures. The latter exemplifies the loss of control which Broders pointed out as the characteristic of the malignant neoplasm.

These two facts, the retention throughout or the dissolution at some point of the cortical contour, and the sharply demarcated or the promiscuous invasion of the adjacent soft tissue structures are the keynote of the roentgenologic differentiation of benign and malignant tumors.

The greatest value of the roentgen rays is, of course, in the decision of the nature of the morbid process. This establishes the prognosis. If the benign tumor is of the osteogenic type, the treatment will be conservative. Obviously, surgical intervention is contraindicated at least until mature growth is attained. Unless demanded because of mechanical interference with function or some other complicating factor, surgical removal of these tumors should not be attempted. Unless every last cartilage cell can be removed or destroyed, these tumors will recur. In recurrence, there not infrequently is a mutation of the cell and a *chondrosarcoma* or an *osteochondrosarcoma* results. These tumors grow slowly; a sudden acceleration of growth and occurrence of new symptoms call for roentgenographic examination and careful search for evidence of dissolution of the cortical contour and promiscuous invasion of the contiguous soft tissues, which indicate sarcomatous change.

Of the nonosteogenic tumors involving bone the benign *hemangioma* is comparatively rare. This neoplasm involves the shafts of long bones, the skull and the vertebral bodies. In the shafts of the bones it occurs in the region of the *metaphysis*; it expands the cortex but does not extend deeply into the medullary or cancellous spaces; the roentgenographic image is that of a "soap-bubble" and is somewhat similar to that of a giant cell tumor. In the vertebral body the image is characterized by vertical *striae* on a background of decreased density. Pathologic fracture is commonly a complicating factor.

The two most important simulants of benign

osteogenic tumors are cysts in bone and giant cell tumors. Solitary cysts of bone almost invariably involve the metaphysis. They probably arise in childhood and may be latent for many years. Pathologic fracture may first call attention to the lesion. Cysts may have their origin in infection or trauma with subsequent hemorrhage. Solitary cysts in the middle of the shaft of bone are usually the result of osteodystrophia fibrosa (osteitis fibrosa cystica), a condition in which the bone marrow is transformed into a fibrous connective tissue that is rich in giant cells. There is a resorption of the compact cortex, followed by replacement with finely porous, and often with uncalcified, new bone. Within these fibrous portions are cysts and so-called solid brown tumors composed of numerous, multinuclear giant cells in a spindle cell matrix containing deposits of hemosiderin. The generally accepted hypothesis is that trauma with hemorrhages into the bone marrow is one of the etiologic factors of this condition. The products of hemorrhage remain localized. Maintenance of functional activity acts as an irritant and produces secondary hemorrhages. Owing to the peculiar structure and circulatory system of bone, a permanent congestion of the blood and lymph vessels is produced. This congestion, together with continuous mechanical irritation, leads to osteodystrophia. With the development of bone, the cyst may be carried toward the central portion of the shaft, producing the localized form of osteodystrophia fibrosa (osteitis fibrosa cystica or fibrocystic disease). Osteodystrophia fibrosa generalisata is now generally recognized as an end-result of advanced parathyroid disease.

The consensus is that giant cell tumor is a granuloma and that it most probably has the same origin as does osteodystrophia fibrosa.

Simple cyst, osteodystrophia fibrosa and giant cell tumor would seem, therefore, to fall in the same category. In these tumors there seems to be a reparative process that has got out of control.

Peculiarly, the situation of a giant cell tumor is preponderantly in the epiphysis, where it apparently has its origin in trauma or infection. The activities of the fibroblasts are outdone by those of the giant cells (osteoclasts). The tumor assumes an asymmetrical position in the epiphysis because it commences beneath the cortex and extends toward the central portion of the

epiphysis at the expense of the cancellous bone. Primarily it is traversed by trabeculae which divide the tumor into several loculi. Later these trabeculae may disappear and may be replaced by a homogeneous flat shadow in the roentgenogram, owing to a lysis in the central portion of the bone; this lysis may extend into the cortex and leave only a thin shell of bone. This thin shell of bone may be expanded until it becomes invisible in the roentgenogram and the tumor may extend beyond the cortex and push the soft tissues ahead of it. At this stage it may be very difficult to differentiate roentgenographically a giant cell tumor and a malignant neoplasm. In a case of giant cell tumor careful study of the outline of the soft tissue shadow will reveal that it has a smooth margin and is intact. A remnant of the cortical shell persists as a wavy outline of bone which passes over the soft tissue shadow at the proximal end of the bone. Occasionally, the shaft of the bone may be telescoped for some distance into the soft tissue shadow. In some cases the evidence of a benign tumor may all be masked and the roentgenographic interpretation may be extremely difficult, but a careful study of the soft tissue invasive shadow will usually reveal some evidence of the continuity of the outline of the shadow.

Periosteal fibrosarcoma (extraperiosteal sarcoma) occasionally presents a roentgenographic image that simulates very closely that of a benign osteogenic tumor or more often that of a giant cell tumor. Periosteal fibrosarcoma invades the bone from without and the destructive lesion in bone, when the bone is involved, is frequently the result of pressure erosion. In such cases the filling defect in the bone has a smooth margin and the continuity of the contour shadow is maintained.

Myeloma is the other malignant lesion that involves bone and simulates a benign tumor roentgenographically. In fact, myeloma violates every principle suggested for the differentiation of benign and malignant tumors. In the shafts of long bones and in the skull this lesion is characterized by multiple, small, discrete filling defects in the bone shadow and the margins are as clear-cut as if they had been made with a steel punch. In the ribs and the shafts of long bones a wide expansion of the shaft may occur and although the cortex may be markedly thinned the contour is always maintained just as it is in the benign osteogenic or giant cell tumor. The

shaft of the bone may even be telescoped into the soft tissue shadow as it is in giant cell tumor. In the spinal column complete destruction of one or more vertebral bodies is suggestive of myeloma. In the shaft of long bones pathologic fracture may occur and this may be the first evidence of the morbid process. In the greater number of cases there is general involvement of most of the skeletal structures and there may be difficulty in distinguishing myeloma from the osteoclastic form of metastatic carcinoma. The roentgenogram of the skull offers the most conclusive evidence of the nature of the lesion.

The characteristics of malignant tumors of bone are best exemplified by osteogenic sarcoma. The gradually diminishing degree of the power of self control is apparent in the perforation of the periosteum and the promiscuous invasion of the contiguous soft tissue structures by the tumor mass. Roentgenographically these changes are demonstrable in the roentgenogram as a dissolution of the contour of the cortex and an inability to trace the outline of the soft tissue shadow. The elevation of the periosteum at the proximal end of the lesion is the remaining evidence of the defensive protective measure of the involved bone set up by the periosteum against the continuous aggression of the tumor elements. Sarcoma predominantly involves the metaphyseal portion of the shaft of long bones and extends into the diaphysis. It may involve the diaphysis. When it involves a large flat bone, such as the os innominatum, the filling defect in the bone has an irregular or serrated margin or fades imperceptibly into the surrounding bone, in contradistinction to the smooth margins and well demarcated outline of the filling defect in cases of benign tumors.

Several subdivisions of sarcoma are recognizable in the roentgenograms: (1) subperiosteal and medullary sarcoma; (2) periosteal sarcoma; (3) sclerosing sarcoma; (4) telangiectatic sarcoma (aneurysm of bone); (5) chondrosarcoma, and the sarcomas involving the diaphysis.

Careful technic often is required to demonstrate a subperiosteal or medullary sarcoma. In one projection the evidence of the lesion may be so slight as to be missed; in another projection the break in the continuity of the cortex and the "promiscuous" invasion of the soft tissue structures will be easily recognized. The periosteal sarcoma exhibits a "sun-ray" of fine linear bony shadows radiating more or less at a right angle

to the axis of the shaft of the bone. In one projection it may be difficult to detect any break in the cortical contour, while in another the characteristic features of the lesion are easily apparent.

The sclerosing sarcoma shows, as the name suggests, an intense eburnation of the involved portion of the bone. Particularly in the upper end of the tibia this tumor may be difficult to distinguish from syphilitic osteitis; only careful study in one of perhaps several projections will reveal the break in the continuity of the cortex. The invasion of soft tissues also tends to be much limited in comparison with other types of sarcoma; it may be so limited as to be difficult of recognition.

The telangiectatic sarcoma (aneurysm of bone) is characterized by a rather extensive bony proliferation in the soft tissues, which in the femur, for example, may very closely simulate a suppurative or other inflammatory lesion of the synovial membrane.

Chondrosarcoma, because of its preponderant cartilaginous content, occasionally offers difficulty in detection of the break in the cortical contour and the soft tissue invasion lacks the extent and the definitely promiscuous features of other types of sarcoma.

The sarcomas involving the mid-diaphyseal portions of the long bones have some of the characteristics of Ewing's tumor, a nonosteogenic tumor which was described as an endothelial myeloma or hemangio-endothelioma by Ewing in 1920.

Ewing's tumor tends to involve the mid-diaphyseal portion of the shaft of long bones, but it may involve any portion; not infrequently, it involves the metaphysis (the growing portion of bone at the junction of the epiphysis and the diaphysis). It rarely affects persons who are more than twenty-one years of age. The bulk of the tumor lies beneath the periosteum; the tumor infiltrates the bone and the bone reacts vigorously with ossification. This reaction is attended with intermittent attacks of fever. The lesion is most often mistaken for osteomyelitis. Roentgenographically, the medullary portion of the bone is not involved. This observation may be of value in the differential diagnosis. In a case recently observed, in which the roentgenographic findings were typical of osteomyelitis of the mid-shaft of the tibia and in which the pathologist reported that the changes were inflammatory,



the patient returned within seven months with all evidences of a periosteal sarcoma.

Subperiosteal formations may be observed; these may be parallel to the bone (onion-skin laminations) or may be at right angles to the axis of the shaft, as are the miniature sun-ray spicules of bone in Ewing's tumor. The onion-skin laminations and the miniature sun-ray bony spicules have occurred synchronously in the same case. In some of the diaphyseal tumors atypical radiations of bony spicules are seen projecting at or nearly at right angles to the axis of the shaft of the bone; in my experience those have proved on pathologic investigation to be osteogenic sarcomas and this diagnosis has been corroborated by the reactions of the tumor to radiotherapy. A helpful point in differential diagnosis has been the soft tissue invasion shadow. In osteogenic sarcoma this is promiscuous in character; in Ewing's tumor it tends to be indefinitely demarcated. In Ewing's tumor the margin of the invasive shadow is not as sharply demarcated as that of a benign tumor and yet it is more distinct than the line of demarcation that marks the osteogenic sarcoma.

Ewing's tumor should not be confused with traumatic sclerosing osteitis or with infectious nonsuppurating osteomyelitis of Garre; these inflammatory lesions do not show any tendency to lamination of the expanded cortical shadow but exhibit a homogeneous flat density throughout. An intact subperiosteal hematoma is usually more closely confined in area and more frequently projects from only one aspect of the bone than is the case in Ewing's tumor. A ruptured subperiosteal hematoma presents lines of ossification that run parallel to the axis of the shaft, and are much coarser and more widely divided than the onion-skin laminations of Ewing's tumor. Green-stick fracture, with the formation of callus, may be difficult to distinguish from this malignant tumor.

The defensive mechanism of the bone against the advance of Ewing's tumor is very similar to that against the advance of a pyogenic infection; it consists of the creation of a bony shell which is called an "involucrum." An interesting fact is that Ewing's tumor, in contradistinction to osteogenic sarcoma, reacts favorably for a time to radiotherapy. Efficient treatment by this method apparently stimulates the defensive mechanism and results in marked accentuation of the density of the involucrum in

the roentgenogram. In all cases of doubt, therefore, a safe procedure is to institute radiotherapy in moderate dosage, as it will be beneficial if the condition is an osteomyelitis. One then should await the results as evidenced in serial roentgenography.

Under such a procedure, some tumors which roentgenographically appeared to be most typical of Ewing's tumor of the shaft were proved ultimately to be osteogenic sarcomas. If careful inspection of the roentgenographic image reveals involvement of the medullary portion of the bone, one should at least suspect osteomyelitis or osteogenic sarcoma.

The malignant angiomas have some of the characteristics of the telangiectatic sarcoma and of Ewing's tumor roentgenographically. Malignant angiomas exhibit an intense subperiosteal proliferation of bony tissue with a subsequent wide invasion of the soft tissues. Under treatment with radiotherapy these tumors show some response, but they do not respond as favorably as does Ewing's tumor.

Metastatic malignant tumors are the result of implants from malignant tumors in parts remote from bone. They have the histologic characteristics of the parent growth. Practically, only carcinoma metastasizes; occasionally one sees sarcomatous lesions in bone that have all the roentgenographic features of metastasis, but the consensus seems to be that these are multicentric growths. The malignant lymphomas (Hodgkin's disease, lymphosarcoma and leukemia) show involvement of bone in a small proportion of cases. Ewing's tumor also tends to involve the skull in the late stages of the disease.

Two distinct forms of metastatic carcinoma are seen. The osteoclastic (melting or melted ice) form is most frequently seen secondary to carcinoma of the breast; it is the usual form seen secondary to carcinoma of the kidney and genito-urinary tract, suprarenal gland, thyroid gland, bronchus and lung, uterus or adnexa, pancreas and biliary tract. Metastasis from carcinoma of the stomach is rare; when seen it has a distinctive roentgenographic image and shows some tendency to assume the features of the osteoplastic form. Occasionally, a slowly growing carcinoma of the breast will produce an image with some osteoplastic features. The lesions of the osteoclastic forms may be localized or there may be a general involvement of the skeletal structures. One portion of a bone may be

completely destroyed, presenting a perfect picture of a malignant lesion that has produced complete dissolution of the cortical contour. There is seldom evidence of any reaction; the roentgenographic image is that of a complete melting away of the shadow of bone over a limited area. Metastasis is seldom seen in the bones of the extremities below the elbows and the knees; when it does occur there is often almost complete obliteration of the shadow of one or a portion of one of the bones, more frequently of the radius in the forearm and the tibia in the leg. Not infrequently, a faint shadow of the cortex will remain. Lesions in the proximal ends of the femur and humerus are the site of pathologic fracture; not infrequently the pathologic fracture may serve to call attention to the metastatic process and occasionally even to the presence elsewhere in the body of a primary malignancy.

In the spinal column the metastatic process may be confined to a single vertebral body or it may involve several isolated vertebrae. Compression of a vertebral body is noted in some cases in which there is evidence of extensive involvement of other vertebrae but no alteration in their architecture. This suggests that pathologic fracture must be a factor in some of the deformities noted. At necropsy, vertebrae have been examined and proved to be so friable that one could force the finger into the substance of the body but visualization of the lesion in the roentgenogram called for the closest scrutiny. Knowing this, one is justified in upholding a clinical diagnosis of metastasis in the spinal column even when it is impossible to visualize the lesion in the roentgenogram.

Localized lesions in the os innominatum, in the pubis, and in the ischium vary from extensive destruction of bone with irregular, serrated or indistinguishable margins to multiple punctate areas of varying size, or "melted ice" areas of varying dimension.

Localized lesions may occur in the ribs; these are usually multiple lesions scattered throughout several different ribs. Not infrequently, in cases in which patients are of advanced age and there is evidence of some general osteoporosis of bone and a diffuse fibrosis of the lung as a result of chronic bronchitis or other cause, the superimposition of the pulmonary markings on the more translucent bone will give the impression of metastasis in the ribs. In such cases, reexami-

nation with heavier exposure and the interposition of the Bucky-Potter diaphragm will often reveal normal bone and obviate an error in diagnosis.

In general involvement of most of the skeletal structures, the bone usually will have a honey-combed appearance; the dimension of the individual defects varies widely; punctate areas may be noted in some parts, and there may be a filling defect of varying size in other parts.

The osteoplastic form of metastatic carcinoma is almost always secondary to carcinoma of the prostate gland. The roentgenographic image of this form is that of a background of bony destruction with a concomitant hyperplasia of bone. The one process usually keeps pace with the other, but not infrequently there are variations in the degree of one or the other, with a resultant diversity of the image. In early cases the involvement is in the inner margin of the ilium on one or both sides, under the overlying wing of the sacrum. This may easily be misinterpreted as hypertrophic changes in the sacro-iliac joints. The lesion may involve one pelvic segment before spreading to other parts of the skeleton. In other cases splotches of hyperplasia of bone which are scattered over the shadow of the ilium on one or both sides may be the early evidence of metastasis. These splotches will increase in size and number simultaneously with increasing evidence of destruction of bone, until the entire bony structure of the pelvis and often the upper portion of the femurs are involved. The destruction and the proliferation may coincide to the extent that there may be a homogeneous eburnation, often extending throughout the skeletal structure. In the spinal column, one vertebral body or several separate bodies will be involved; rarely this may be the only evidence of metastatic involvement.

The recognition of the metastatic involvement by roentgenographic examination may be the first intimation of carcinoma of the prostate gland. Occasionally, carcinoma may not be demonstrable by physical examination, even after metastasis in bone has been discovered.

The noninflammatory condition which simulates osteoplastic metastasis is osteitis deformans (Paget's disease). In some cases this may offer considerable difficulty in differential diagnosis. Both diseases affect men who are in the same period of life, and both are frequently incidental findings in routine examinations.

Osteitis deformans may, similarly to carcinomatous osteitis, involve a single pelvic bone before involving the whole skeletal structure; a coincidental secondary anemia is present alike in cases of benign osteitis and carcinomatous osteitis.

In benign osteitis, or osteitis deformans, the evidence of the trabecular elements of the bone is maintained or exaggerated; in carcinomatous osteitis it is always obliterated in cases in which the differential diagnosis is difficult. In osteitis deformans there is an enlargement of the shadow of the bone owing to subperiosteal deposition of osteoid tissue; in carcinomatous osteitis there is no enlargement of the bony shadow. In cases in which the femurs are involved, there is a widening of the cortex and a bowing of the shaft; this feature is absent in carcinomatous osteitis.

Roentgenographic examination of the cranium and the tibia will reveal pathognomonic roentgenographic images if the lesion is osteitis deformans.

### Summary

In this necessarily brief review an attempt has been made to point out the salient roentgeno-

graphic characteristics of lesions involving bone. In competent hands the roentgenologic method is a rapid and accurate method of determining the etiologic factor in the majority of lesions involving bones and joints. Careful subsequent correlation of the roentgenographic, the clinical and all other findings should be carried out in every case before the ultimate diagnosis is arrived at, and before the therapeutic measures are instituted. Surgical intervention should always be preceded by biopsy under control of a tourniquet, and the decision as to the procedure should always await the results of microscopic examination of the excised tissue. Under such circumstances the roentgenogram is of inestimable value; in fact, one can truly say roentgenology has become one of the indispensable methods in general diagnosis.

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## THE ROENTGEN TREATMENT OF INFLAMMATORY DISEASES\*

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IN considering the use of the roentgen ray in the treatment of inflammatory conditions, it must be borne in mind that a whole group of circumstances and developments must be evaluated. One of the first of these is that, until comparatively recently, roentgen rays were used more or less empirically. The instability of the old gas tube, the variation in the quantity and quality of the radiation it produced, the absence of the auto-transformer, the lack of knowledge of filtration as it affects wave-length and depth dose and the entire lack of scientific instruments for measuring roentgen dosage made x-ray therapy, in its early days, more or less unreliable.

Gradually x-ray equipment has been improved. The auto-transformer, the mechanical

and valve-tube rectifier, the hot cathode tube, the spectroscopic, the electroscope and the r-meter were developed gradually and today are accepted equipment in constant use. These have enabled the radiologist to duplicate, from day to day, the potentials and currents that are needed, and uniform settings and equivalent energies are obtainable at will. Contemporaneously have come methods of studying biological effects and the responses of various types of tissues to ionizing influences. Consequently roentgen therapy has been put upon a sound foundation and must be considered a scientific procedure.

During the development of these various steps in the physical progress of x-ray therapy, radiologists were more and more inclined to concentrate their efforts on the treatment of malignancies and more or less neglect the milder lesions. However, inflammatory lesions have

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been treated since 1900 and the beneficial effects of the x-ray in acne, furunculosis and erysipelas are well known. Even the recently much-advertised therapy for sinusitis has been used by the radiologist for fifteen years. About eight years ago, Desjardins<sup>2</sup> summarized the results of several years of experience in treating inflammatory conditions and his explanation of the action of the roentgen rays is still authoritative. During this time, also, biophysicists, biochemists and pathologists have been studying the effects of roentgen irradiation on healthy and inflamed tissue. Their observations and recorded findings have brought roentgen therapy into the field of accepted therapeutic agencies.

In applying roentgen irradiation to inflammatory areas the method of application has much to do with the successful outcome of the therapy. It is not sufficient merely to subject the patient to more or less haphazard exposure under an x-ray tube, without giving thought to the invading organisms, the tissues involved or the lymph drainage system of the locality. The nature of the infection, its methods of spreading and the toxic manifestations it produces are important considerations. The depth of the infection in the tissues modifies, to a certain extent, the potential at which the machine is set; the acuteness or chronicity of the lesion indicates the interval of time between treatments; and the probable duration of the disease determines the number of r to be administered at each treatment. As a rule, smaller doses at rather frequent intervals produce better results than larger doses at greater intervals. This has been clearly shown by extensive experimental work carried out in Leningrad. It was noted that the dose-time interval is important. Small doses given every other day had much better effect than larger doses given every fourth day, although the total amount of radiation was the same. This is readily understood when it is realized that only a short time is required to break down the phagocytic cells of the blood, liberating the antibodies or other substances therein contained. These antibodies act as anti-toxins and have definite phagocytic properties after liberation. It must be remembered that the metabolism and function of parenchymal and connective tissues are increased by inflammation; therefore, physically equal roentgen doses have much greater effect on inflammatory tissue than on normal tissue.

An editorial in the *Journal of the American Medical Association*<sup>3</sup> reads, in part, as follows: "Roentgen irradiation appears to be capable of aborting many of the early infections and of promoting the breaking down and localization of the more advanced lesions. The roentgen rays are not in themselves bactericidal. The favorable action is believed to be due to the breaking down of certain radio-sensitive cells and the consequent liberation of powerful anti-toxic substances."

The amount of irradiation required in the treatment of infections is small as compared with the larger doses ordinarily considered in the treatment of malignant tumors. Surrounding normal tissue is included in the field of application and the lymph drainage areas must certainly be reached. It is advantageous to begin therapy in the lymph drainage areas if possible and then cover the focus of infection. This plan should be followed in such a manner that one area is treated daily, and no time interval of any magnitude intervenes. Kaplan<sup>6</sup> states that "while x-rays are not bactericidal, they possess the power to stimulate within tissues certain responses, as hyperemia and destruction of leukocytes and lymphocytes with the liberation of endotoxins which possess the power of phagocytosis. The employment of x-rays for the treatment of inflammatory conditions is rational procedure."

Time is an important factor in the treatment of infections. Roentgen therapy, in addition to all other kinds or types of therapy selected, should be started early. The most prompt effects and the best results are obtained by early application. It is a well known fact that x-rays increase both the local and general resistance to infection and the tendency toward secondary infection is lessened. This local increase of tissue resistance continues for three or four weeks, after which it gradually declines to normal. It exists only in the area treated and does not extend to adjacent tissues. There is no cumulative action which might lower tissue resistance. Healing takes place normally and neither the diseased tissue nor the healthy tissue surrounding it is injured by the treatment.

It must not be believed that roentgen therapy should be used to the exclusion of any other therapy, neither should it be used as a last resort; it should be considered an adjuvant and be thought of in every infection. Kelley and



Dowell,<sup>7</sup> in an analysis of fifty-six cases of gas bacillus infection, recommend that the patient be treated with x-ray as soon as the presence of the infection is suspected. They believe that such treatment, combined with serum treatment, tetanus antitoxin, local surgical procedures and antiseptics, removes the necessity of amputation. They report a mortality of less than 10 per cent.

In the treatment of lobar pneumonia, Powell<sup>9</sup> gives the results of the treatment of two groups of patients. In both groups the treatment by all other means of therapy remained the same, but one group received the serum and the other group roentgen therapy. In the group which received serum the mortality was 15 per cent, while in the group which received x-ray the mortality was 5 per cent. These statistics agree with those published elsewhere, particularly in Europe, where the mortality rate for all types of pneumonia without serum or x-ray treatment is given as 30 per cent, with serum 15 per cent and with x-ray 5 per cent. These results are due to an early crisis brought about by the x-ray therapy and it is explained by the statement that a certain lysin is liberated from the infiltrating leukocytes which causes rapid solution of the coagulum which is the principal component of the consolidation.

Recent experimental work by Fried<sup>4</sup> on guinea pigs with artificial pneumonia produced by emulsified cultures of hemolytic staphylococcus aureus showed marked consolidations in the control animals while the irradiated animals showed only scattered small areas of consolidation. The irradiated lungs showed less congestion, less edema, less infiltration of tissue and fewer abscess formations.

In substantiation of these findings and results I quote from Boyd<sup>1</sup>: "Acute inflammatory lesions \* \* \* are amenable to radiation. Exposure at an early stage causes rapid resolution. It seems strange that an agent which destroys the inflammatory cells should benefit the lesion. The probable explanation is that protective substances are liberated by the disintegrating polymorphonuclears and lymphocytes."

The infectious involvements of the nasal accessory sinuses, the mastoids and the middle ear are quite aggravating. After all other medical and surgical procedures have been used and have been found insufficient to relieve the symptoms, a majority of the patients can be benefited by roentgen therapy, provided care in its adminis-

tration is used. Many exorbitant claims have been made of the results obtained in the treatment of this class of infections and, as a result, some discredit has been reflected on roentgen therapy in all infections. The fact remains, however, that the method of application and not the therapeutic agent itself was at fault. Lucinian<sup>8</sup> reports favorably on the treatment of otitis media and catarrhal deafness, and the works of Woolley<sup>10</sup> and Hodges<sup>5</sup> on sinus infection are well known.

All types of infection have been successfully treated with roentgen rays. These include such conditions as arthritis, parotitis, bursitis, peritonsillar abscess, pyorrhea, endocarditis, bronchiectasis, puerperal mastitis, peritonitis, localized cellulitis, adenitis, endometritis and many others. There is a possibility that any infection may be treated by x-ray if the treatment is administered with caution and the general principles of small doses, repeated frequently, followed. Let me quote from the paper of Desjardins,<sup>2</sup> published seven years ago, whose description of the accepted physiological action of roentgen therapy in inflammation cannot be surpassed. He says: "The infiltrating cells contain or elaborate within themselves the protective substances or other means which enable them to destroy or neutralize the bacterial or other toxic products which give rise to the defensive inflammation. If these assumptions are well founded, it seems not unreasonable to deduce that irradiation, by destroying the infiltrating leukocytes, causes the protective substances contained by such cells to be liberated and to be made even more readily available for defensive purposes than they were in the intact cell."

Founded on such a reasonable premise, the clinical application of the roentgen rays in inflammatory reactions is practicable, efficient and scientific practice.

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## HISTORY OF MEDICINE IN MINNESOTA

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### HISTORY OF MEDICINE IN RAMSEY COUNTY

BY J. M. ARMSTRONG, M.D.

*(Continued from November issue)*

#### 1853

At the beginning of 1853 there were ten physicians practicing medicine in Saint Paul: Drs. J. H. Day, Goodrich, Barbour, Dewey, Vicchers, Potts, Mann, Brisbane, Babbitt and Willey. David Day was at this time at Long Prairie, and Borup was not practicing.

On March 17, Babbitt's card disappeared from the papers and Dr. Barbour's was discontinued a month later. Whoever was Coroner this year was apparently not filling his office, for on the 20th of April Dr. Mann was appointed by Truman M. Smith, Justice of the Peace, to hold an "inquisition" on the body of a man who met his death by the shifting of a cargo of lumber on one of the river boats. Two more physicians came to Saint Paul: Dr. Wm. H. Morton, of Patterson, N. J., on May 30, and Dr. L. C. Kinney in July. Dr. Kinney stated in his professional announcement that he had been in practice ten years, one of which he spent with the army in Mexico. He took an office in Holland Place, in a two-story frame building that stood on St. Anthony Street opposite the site now occupied by the West Publishing Co.

Dr. Morton seems to have been in no hurry to start in business, for his professional card did not appear in the paper till December 8, when he associated himself with Dr. Potts. They took an office over H. C. Sanford's store situated on Third Street just below Wabasha. Previous to this time Dr. Potts' professional card remained the same as it was in 1849.

This year marks the beginning of medical societies in Minnesota. At this point we must digress a little to settle a point in history which may as well be cleared up now as later.

Our present Minnesota State Medical Association was organized as the Minnesota State Medical Society on February 1, 1869. Its first volume of transactions was published in 1870. This first volume of transactions contains the minutes of the preliminary meeting held for the purpose of organization, a list of those signing the constitution, and the statement that Dr. Thomas R. Potts, president of the old Society organized in 1855, now defunct, presided at the formation of the present Society. In 1925, the Council of our present State Association, finding that the archives of the Association did not have a copy of the first volume, had it reprinted from the only copy available which was and is now in the Library of the Ramsey County Medical Society. As regards the date, 1855, the statement is erroneous, the date should be 1853. The *Pioneer* for July 28, 1853, states:

"In pursuance of a call publically given by the papers of the Territory, physicians representing different counties and towns met in St. Paul on Saturday 23, inst., at the Court House and made a temporary organization, by calling Dr. Potts to the chair and Dr. Anderson Secretary. The Convention then organized, soon admitted the propriety of forming

## HISTORY OF MEDICINE IN MINNESOTA

a Medical Society, and went into a committee of the whole, Dr. Murphy in the chair, to deliberate upon forming a constitution. At half past twelve the committee rose, to meet at two o'clock at Dr. Mann's office.

"Afternoon Session—The attendance being punctual, the convention resolved itself at once into a committee of the whole, Dr. Murphy in the chair, when a plan of Constitution and By-laws was reported, accepted and the committee discharged, Dr. Potts in the chair. A Constitution made up mainly from those in force in Pennsylvania and Illinois, was now taken up and considered by sections, and with various additions and amendments adopted, together with a set of By-Laws and the American Association's Code of Ethics. Drs. Ames, Murphy, and Mann were now appointed a committee to select permanent officers and committees for the ensuing year: who reported—

"President—Dr. Potts, St. Paul

"Vice Presidents—Drs. Ames, All Saints, and Murphy, St. Anthony

"Corresponding Secretary—Dr. T. T. Mann, St. Paul

"Recording Secretary—Dr. Anderson, St. Anthony."

An abbreviated statement of the proceedings may also be found in the *Northwestern Medical and Surgical Journal* (Chicago) for August, 1853. Corroborating these we find the following from the pen of Dr. Wm. W. Finch, of Saint Paul, in "Physicians, the Climate and Diseases of Minnesota" (*Boston Medical and Surgical Journal*, Oct. 12, 1853):

"On the 23rd of July, 1853, the first Medical Society was organized in this territory and christened 'The Minnesota Medical Society.' Considering that there are scarcely twenty regular physicians in the territory, the meeting was well attended, matters were discussed in a friendly manner and the following officers chosen: Dr. Potts of St. Paul, President; Dr. Ames of Minneapolis, and Dr. Murphy of St. Anthony, Vice Presidents; Dr. Anderson of St. Anthony, Recording Secretary; Dr. Goodrich, Treasurer; Dr. Mann, Corresponding Secretary; and Drs. Day, Dewey, and Finch, Censors. The last five officers are residents of St. Paul. Though few in numbers, we mean to do what we can to sustain and advance medical science in this new territory, and we hope to receive the good wishes at least of the older societies in the states."

If these two citations are not sufficiently convincing that the society was founded in 1853, we find in the Transactions of the American Medical Association of the St. Louis meeting of 1854, that John H. Murphy, Falls of St. Anthony, attended the meeting as a delegate with credentials from the Minnesota Medical Society. Murphy was the first Minnesota physician to belong to the American Medical Association, but while this is true we must state for the benefit of those not informed that Minnesota Territory did not exist until 1849, and just previous to that date the eastern part of our state was part of Wisconsin Territory, and that Dr. A. E. Ames, of Wisconsin, was a member of the American Medical Association in 1848. Ames, however, at that time was not a resident within the present limits of Minnesota. From the *St. Anthony Express*, which contains the best account of this meeting, we learn that Dr. A. E. Johnson of St. Anthony also personally attended the meeting and that Dr. A. W. Daniels of St. Peter and Dr. O. P. Marsh of St. Paul signified their desire to belong and were marked present by request; and that Drs. J. H. Day, A. G. Brisbane and Samuel Willey of St. Paul, together with Dr. Carli of Stillwater and Dr. Chas. McDougall of Fort Snelling, were made charter members, though not actually present. Dr. McDougall had recently arrived at Fort Snelling, relieving Dr. Ames who was Contract Civilian Surgeon there till McDougall arrived. Dr. McDougall, a native of Indiana, entered the army in 1832 and retired in 1869. He was made a Brevet Brigadier General in 1865 for gallant conduct in the field. A meeting of the Society was scheduled for January 1854, but apparently was not held, though it is possible that some data regarding it may yet be found. Mrs. Abbott, widow of the late Dr. Everton J. Abbott and daughter of Dr. John Steele, says she re-

members having a minute book of a medical society and using it for a scrapbook when she was a girl. The book was not destroyed till after Dr. Abbott's death when the family moved to another residence. Possibly, it was the minute book of this Society.

As regards the further activities of this Society, the St. Paul City Directory for 1856-1857 states:

Medical Society of Minnesota—organized December, 1855.

Officers for 1856-7:

Dr. Thomas Potts, President

Dr. J. H. Murphy, Vice President

Dr. J. V. Wren, Recording Secretary

Dr. James D. Goodrich, Corresponding Secretary

Dr. David Day, Treasurer

Dr. W. H. Morton, Dr. F. R. Smith, Dr. J. H. Stewart, Dr. A. E. Johnson, Dr. A. E. Ames—Censors

Dr. R. W. Wing, Dr. O. P. Marsh, Dr. C. L. Anderson—Standing Committee.

Note that the date "1855" appears again. The word "organized" should be "reorganized" at a meeting held in December, 1855. However, the paper for January 5, 1856, says the meeting was held in Dr. Wren's office January 3, 1856, and gives the additional information that Dr. LeBoutillier was chosen essayist. Evidently, this is where the date 1855 came from in the 1869 transactions of our present Association, and also because of no meeting in 1854 a reorganization was effected in 1855. It is known that the Constitution and By-laws of this Society were printed in 1856, but no copy of it has yet been found. The last meeting of the Society was held at St. Anthony in 1857, the officers being the same as given in 1856 with the exception of the censors, who were Drs. W. H. Morton, F. R. Smith, J. H. Stewart, A. E. Johnson, and A. E. Ames. No account of this meeting can be found, the files of St. Anthony and Minneapolis papers being incomplete for that year.

There is evidence then that the Society was active during the years 1853-55-56 and 1857. Our information as to this Society ends here unless further research discloses more data. It will be noted that Dr. Potts was its first and last recorded president. It is probable that the reason Potts was elected president is that he was a much older man than any of the others. In fact, Minnesota at that time was populated chiefly by comparatively young men, and Potts, in 1853, was forty-three years of age and one of the oldest men here. It is further probable that the panic of 1857 killed the Society as it nearly killed all business activities in the Territory. The preceding remarks as to Doctor Potts and the demise of this Society are not founded alone on my own surmises, but Dr. C. E. Smith, Sr., and Dr. Alfred Wharton were of the same opinion. Both of these physicians knew of this Society but had no further recollection of it. St. Paul, in 1850, had a population of 1,294, Ramsey County (then including St. Anthony), 2,197, and the entire territory, excluding soldiers, but 4,780, while in 1860 St. Paul had 10,279 inhabitants and the county 12,150. So the proportion of physicians to the number of inhabitants was excessive, which accounts for the many changes. Every steamboat, however, during this period brought in a cargo of immigrants, speculators, and adventurers.

This same year (1853) Bishop Cretin laid the cornerstone of St. Joseph's Hospital on the same site as the present building, though it was not open to patients till the following year. This was the first hospital in the state other than the military hospitals. It served not only as a hospital but as a home for orphans and the aged and housed the sisters. For some years after 1859 it was



occupied by St. Joseph's Academy. Until our city and county hospital (now the Ancker Hospital) was established in 1882, the city and county patients also were cared for at St. Joseph's.

In July, Dr. Babbitt moved his office from St. Anthony Street to Main Street (West Fourth), between St. Peter and Market Streets. It would seem that ten physicians were not enough for St. Paul, for in July, Dr. O. P. Marsh arrived and took an office on Third Street next to the Post Office (below Wabasha). In October the election returns showed that J. E. Fullerton, Whig nominee for coroner, was victorious over Patric Carey, the Democratic nominee. On November 17, the *Pioneer* published on its editorial page a "Business Directory" of St. Paul and gave the names of fourteen physicians. In addition to those already mentioned the names of Drs. Alfred Berthier, Wm. W. Finch, and David Day were listed. The latter had been physician to the Winnebago Indians at Long Prairie since the spring of 1852. He was still there in 1853, but it was stated in parentheses after his name that "he will take up his residence in St. Paul in the spring." Dr. Day was succeeded at Long Prairie by Dr. Frederick Andros, of Iowa, who had also preceded him in the same position. This same business directory also stated that the druggists in St. Paul were Bond and Kellogg, Wm. W. Hichcox, Wm. H. Jarvis, and John J. Dewey, and that the capital invested in the drug business in our city was \$31,000. Kellogg soon went out of business and the firm became Bond and Axtell. At this time there were five physicians in St. Anthony: Drs. J. H. Murphy, A. E. Johnson, Charles L. Anderson, Kingsbury, and Z. Jodon. St. Paul consisted of 700 buildings and 4,700 inhabitants. Although Dr. Finch was in St. Paul before November 17, his professional announcement in the *Pioneer* did not appear till January 5, 1854. It is interesting in its reference to the use of ether.

"Being familiar with the use of ether, operations in surgery will be performed under its influence without pain, if desired."

The "if desired" seems incomprehensible to us now. Doctor Finch gave as reference Professor McClintock, of the Philadelphia College of Medicine, and Professor Perkins, of Vermont Medical College. Dr. Mann, late in the year, was appointed physician to the Sioux Indians, but retained his residence in St. Paul, since the Sioux were still living at Kaposia (Little Crow's Village). On November 10, Oakland Cemetery was ready for use. Governor Ramsey was president of the Association and Dr. Borup one of the Board of Trustees.

Harry Birmingham, who had been Assistant Surgeon at Fort Snelling for four years, located in St. Paul during the year. He never practiced there, however, but was in the drug business for a time. Dr. Thomas W. Foster, a resident of Hastings, was later a druggist in St. Paul. A son of Dr. Birmingham became a surgeon in the army and died in 1932. Dr. Henry Birmingham died in St. Paul, September 25, 1891. St. Paul, at the end of 1853, had thirty physicians. Three of them never practiced, and Wm. H. Jarvis, as a homeopath, probably did little except counter prescribing at his drug store. A homeopath at that time simply meant that a man bought a book on homeopathy and announced himself as a physician of that cult.

It was during this year that some Chippewa Indians hid under the wooden steps of the Pioneer Building all night in order to waylay any Sioux that might come into town the next morning from Kaposia. Early in the morning of April 27, a canoe containing Old Bets, her sister, and Wooden-legged Jim, her brother, landed at the foot of Jackson Street and the three walked up to the store of the Minnesota Outfit.

It was the intention of the Chippewas to ambush them at the landing, but the marsh between Fifth Street and Third Street prevented them, and the unsuspecting Sioux, circling the flooded area, reached the store before the Chippewas opened fire. Old Bets' sister was mortally wounded, and wooden-legged Jim had a splinter knocked off his wooden leg by a ball as he rushed out of the store to discharge his old pepper-box pistol. Dr. Goodrich dressed the woman's wounds, and at her own request she was taken back to Kaposia, where she died.

Two new life insurance companies entered St. Paul this year: the Mutual Life of New York, for whom Dr. Potts served as medical examiner; and the New England Mutual Life, who employed as examiner Dr. G. S. Sperry. Sometime during the year, Dr. Ebenezer Miller came to St. Paul from Vermont. He was the father of the late Dr. Clinton C. Miller. He never practiced medicine in St. Paul, however, and died in Louisiana, July 21, 1865. Among the distinguished visitors to St. Paul in 1853 was Dr. Marshall Hall of London, famous for his studies of the physiology of the nervous system.

## 1854

Although most of the physicians who were in St. Paul at the end of 1853 remained there during the following year, the practice of inserting cards in the papers went out of fashion, and the historian is forced to rely upon other sources of information. In February, Dr. Marsh's card disappeared, and a few weeks later advertisements inserted by Dr. Goodrich and Dr. Dewey were discontinued. By the end of the year only three physicians' cards were published in the *Pioneer*; those of Drs. Sperry, Kinney, and J. H. Day. Of these, the last mentioned had left town.

In February, smallpox became epidemic among the Chippewa Indians, and their condition became so bad that the governor appointed Dr. Mann to render medical aid to them. Mann, however, found it inconvenient to leave town and deputed Dr. J. H. Day to act in his place. Day left St. Paul on March 25, and returned sometime in April. He and his guide and interpreter first went to St. Croix Falls and then westward. It was a very arduous trip. The *Pioneer* for May 2 contained a long report made by Dr. Mann to Governor Gorman on the subject. The condition of the Indians was deplorable. Not only were they afflicted with the smallpox; they were destitute as well. In one village, Dr. Day found but seven out of a band of fifty-four alive.

A business directory published in the *Daily Times* for May 16 gave the names of fourteen physicians as follows: Brisbane and Willey, A. Berthier, J. H. Day, J. D. Goodrich, John J. Dewey, C. L. Vicchers, W. W. Finch, David Day, O. P. Marsh, T. T. Mann—Sioux physician, Potts and Morton, and Barbour. In June, Dr. Finch's card was withdrawn from the papers, though he was apparently still in St. Paul as late as October, when he went to Clinton Falls. Early in May the citizens of St. Paul began to be worried by the development of cholera along the river, and a health officer and city physician was appointed. The history of cholera in St. Paul will be discussed in another place.

On June 20, William W. Hichcox, the druggist, who was a man of violent temper, had a dispute with a drayman named Peltier over some drayage charges. As Peltier drove away from the drug store, Hichcox caught up an axe and followed him, running up alongside the cart. Peltier, sitting in the dray, caught up an iron dray pin and swinging it out to ward off the axe, struck Hichcox on the head, fracturing his skull. Hichcox's skull was trephined to raise the depressed bone, but he died on July 3. Charles Bazille, who was coroner at the time, impaneled a jury, and at his order a post-mortem examination was made by Dr.

Morton assisted by Drs. Goodrich, J. H. Day, and Marsh. Peltier was later tried for homicide but was acquitted on the plea of self-defense. Peltier left St. Paul after his acquittal and went to Canada, where he became a monk, a very learned man and teacher. Dr. William G. LeDuc of Hastings witnessed the encounter of the two men. The story of Peltier's later life is recorded from his testimony. It may be of interest to note here that while General LeDuc was attending Harvard Law School in 1849 he was engaged by the *New York Tribune* to report the trial in Boston of Professor Webster, who was charged with the murder of Dr. Parkman.

After Hichcox's death, Dr. David Day, who was appointed administrator of his estate, took over his drug business on the southwest corner of Third and Cedar Streets, and continued it until 1866. In August, a new physician came to town, a Dr. George Hadfield, homeopath. He took an office on Third Street, one door above Buell's store (presumably just below Wabasha). During August, also, Dr. Sperry, who already had been in St. Paul for some time, inserted his professional card in the paper as a "Homeopath, office on Third Street opposite C. E. Mayo and Co.; Residence at Winslow House." Later in the year he changed his announcement, inserting "M.D." after his name, and moved his residence to the Central House (Third and Minnesota Streets). Sperry got into some trouble and left town suddenly about 1859.

Dr. J. H. Day concluded that Kansas and Nebraska territories offered advantages over Minnesota, and in August he left St. Paul and settled at Leavenworth. Dr. L. C. Kinney bought out the World's Fair Drug Store at Third and Robert Streets from William H. Jarvis, and also opened a branch store in upper town at the Winslow Block. At the Democratic primaries in the autumn several candidates sought the nomination for the legislature, among them Drs. Willey and Goodrich. Neither man received the nomination or polled many votes, and both disclaimed any desire for the office—after the election. By a peculiar vote William H. Jarvis was chosen coroner. There were four candidates, H. A. Schlick, Lott Moffet, S. C. Cave, and William H. Jarvis. Jarvis received 342 votes and the other three one vote each. The year 1854 was a banner year for new physicians to locate at St. Paul, more so even than 1851. Among the men to arrive were the following: Thomas J. Vaiden (September 2 or 3), George W. Huntington (October 17), A. E. Boyd, and Louis Francis Tavernier. Dr. Thomas W. Foster, who had been living in Hastings, returned to St. Paul during the year and became actuary and executive for the Oakland Cemetery Association. He and Dr. David Day were also active in the organization of the Board of Trade on November 29. Dr. N. Barbour remained in town and became one of the officials of the Sons of Temperance.

As to Dr. Huntington little further is known. His card was discontinued in November, and he seems to have remained in St. Paul only a short time. Vaiden probably never practiced but interested himself in real estate. He was an elderly man with long dark hair, a gentleman, very reticent as to his affairs, and almost a recluse. More will be said of him later. Boyd remained in town a few years, practicing homeopathy, then moved to a farm in New Canada Township. Later, he came back to St. Paul, where he died June 4, 1888. It is said he knew Dr. Hadfield before coming to St. Paul. Neither he nor Tavernier, however, played any part in the medical history of St. Paul or Ramsey County. Tavernier left to practice at Fort Atkinson, Iowa, for a short time, but returned and died in St. Paul, January 26, 1870, aged fifty-three years. He was a French Canadian. Both Boyd and Tavernier left families in St. Paul.

(To be continued in January, 1939, issue)

## EDITORIAL

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#### BUSINESS MANAGER

J. R. BRUCE

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#### The Oral Use of Neoprontosil in the Treatment of Chronic Ulcerative Colitis

THE possible efficiency of certain sulfamido  
compounds in the treatment of chronic ulcer-  
ative colitis was foreseen soon after clinical use  
of these drugs was instituted. This interest in  
the therapeutic possibilities of these drugs prob-  
ably was aroused by the fact that these com-  
pounds were effective in the treatment of dis-  
eases resulting from infection with hemolytic  
streptococci. It followed, therefore, that some of  
the sulfamido compounds might be of value in  
the treatment of chronic ulcerative colitis since  
this disease may be due to a related organism.

The early experience of Bannick, Brown and

Foster, which has been confirmed by Collins and  
others, seemed to indicate that sulfanilamide was  
of definite benefit in ulcerative colitis. However,  
as was pointed out later by Brown, Herrell and  
Bargen, the occasional appearance of rather se-  
vere toxic manifestations subsequent to use of  
this drug makes the use of sulfanilamide some-  
what undesirable. In fact, the general experience  
of most of those interested in this form of treat-  
ment leads, now, to the conclusion that sulfa-  
nilamide is not the drug of choice in treatment of  
this disease. Especially is this true if patients  
are acutely ill and if there is a rather extensive  
ulceration of the colon.

In the search for a similar preparation which  
might possess the therapeutic efficiency of sulfa-  
nilamide, without the severe toxic manifesta-  
tions which prohibit its administration to se-  
verely ill patients, neoprontosil was suggested by  
Bannick and Brown. At that time, however,  
neoprontosil was available only in a 2.5 per cent  
solution to be administered parenterally. The  
inherent chronicity of chronic ulcerative colitis  
and the necessity of long continued use of any  
therapeutic agent were somewhat against any  
parenteral medication. Then too, as was shown  
by Rosenthal, 85 to 95 per cent of this drug,  
when given parenterally to experimental animals,  
was excreted in the urine within five hours.  
This fact meant that the concentration of the  
drug could not be held at a high level without  
repeated injections at short intervals. The experi-  
mental work of Raizess and Rosenthal, working  
independently, indicated that if the drug could  
be given orally it would be more slowly absorbed  
and thus would be retained in the body for a  
longer time. Such retention would allow for  
greater concentration and, therefore, for greater  
therapeutic efficiency. Therefore, the material  
was obtained in powdered (capsule) form and  
was first administered clinically by Brown, Ban-  
nick and Herrell. In a representative group of  
unselected cases of ulcerative colitis, the results  
following oral administration of this material  
were better than the most optimistic expectations.

The dosage employed was similar to that used  
in the previous oral administration of sulfanila-  
mide. To the average adult, amounts of between



4 and 5 gm. of this drug, divided into five equal parts, were given in each twenty-four hours. In other words, 15 grains (1 gm.) were usually given an hour before each meal, at bedtime, and at 2 a. m. Such a course was administered usually for ten to fourteen days. It seems apparent that if the drug is given an hour before the intake of food, most of the gastro-intestinal symptoms usually associated with sulfamido compounds will be eliminated. Subsequent to a course of this dosage, experience has indicated that a smaller dosage, of approximately 2.5 gm., given daily for another ten to fourteen days, is advisable. Following this again a larger dosage may be employed for at least the first three months of treatment.

In addition to the marked clinical improvement, the lack of toxic manifestations following the use of this drug is apparent. For example, Brown and Herrell reported, following administration of neoprontosil orally to nearly 500 patients, that depression of the leukocyte count was seen only once or twice. It is further interesting that among those individuals with chronic ulcerative colitis, whose stools are rather markedly hemorrhagic and number from four to fifteen per day, both quantity of blood and number of stools are markedly decreased by the third or fourth day of treatment. In other words, blood disappears from the stools of these individuals long before healing of a rather severely denuded bowel would seem possible. It is also interesting that the proctoscopic appearance of the mucous membrane in cases of rather severe ulcerative colitis has been reported to be normal often as early as two or three weeks following administration of neoprontosil. It is proper, however, at this point to emphasize a pertinent observation made by those individuals originally responsible for the administration of this drug in ulcerative colitis; namely, that it is impossible for any chemotherapeutic agent to restore to normal the physiologic function of a bowel which has become contracted and deformed by chronic ulcerative colitis of long standing. If, however, neoprontosil is used early in the course of chronic ulcerative colitis, rather remarkable results may be expected. It is further worthy of emphasis that those who are responsible for the use of neoprontosil have stated repeatedly that they do not pretend to have discovered the cause or the absolute cure of chronic ulcerative colitis; they do feel, however,

that continuous use of the drug is amply justified on the basis of clinical experience in the past year.

At present only impressions exist concerning the mode of action of neoprontosil in the treatment of chronic ulcerative colitis. Some general beliefs, however, are justifiable in view of what has been observed clinically and following use of the drug in experiments on animals. Certainly, the therapeutic response cannot be explained on the basis of the sulfanilamide which is made available in the systemic circulation by the breakdown of neoprontosil. In other words, it appears that neoprontosil has an action wholly independent of the available sulfanilamide. Neoprontosil often appears in the stools of human subjects as soon as twelve hours following its oral administration. The clinical results would seem to indicate that at least part of the drug is absorbed through the lower part of the intestinal tract and thereby exerts its efficiency to encourage healing of the mucous membranes. The experimental work of Marshall, however, would tend to indicate that absorption does not take place in the large bowel of experimental animals. This observation, of course, does not necessarily mean that absorption is not possible in the lower part of the intestinal tract of man. It is further possible that the mere presence of the drug in direct contact with the lower part of the bowel may exert a local action independent of that made possible by absorption into mucous membranes or into the systemic circulation.

Certainly, the marked clinical response reported following oral administration of neoprontosil in the treatment of chronic ulcerative colitis is stimulating and it is safe to say that this drug deserves clinical application in an effort to evaluate its efficacy.

WALLACE E. HERRELL.

### Medicine and Music

**G**REAT musicians have seldom come out of medicine. Fritz Kreisler was a medical student but never graduated. His whole career has been centered in his violin; his medicine was merely a passing incident in his youth, wholly obliterated by his genius in his music.

Theodor Billroth (1829-1884) was a great surgeon and unusually well qualified as a musician. He was a close friend of Brahms and

wrote a classic on the physiology and psychology of music entitled "Wer ist musikalisch?" which was published after his death. While his standing in the musical world did not compare with his fame in surgery he believed that the two were complementary and that the study of music greatly aided his inventive genius as a surgeon. That he had the inherent quality of a real musician is shown in the words he wrote a few hours before his death:

"It is night and everything has been quiet for a long time and now I am very calm. My mind begins to wander. An ethereal blue sky envelops me. My soul soars upwards. The most beautiful harmonies of invisible choirs are audible—in soft undulations like the breath of eternity! I also recognize voices and the gentle whisperings: 'Come, tired man, we will make you happy. In the charm of these spheres we will free you of the thoughts which have been of the greatest joy or deepest sorrow. You have felt yourself as a part of the universe, now be distributed through the universe and comprehend the whole.'"

He died, world-renowned in surgery, but with only local repute as a talented performer and music lover.

Alexander Borodin (1834-87) began his career as a general practitioner but soon dropped it to take up chemistry, in which he became quite eminent, contributing numerous articles to the literature and being credited with being the co-discoverer of aldol, with Wurtz. As a child he had shown marked talent for music and had been given instruction in the piano and cello, in both of which he became proficient. At thirteen he wrote a concerto for the flute. Later he joined the circle of Balakireff, enjoying the companionship of the youthful group which included César Cui, Moussorgsky, Rimsky-Korsakoff and Glazounoff, who laid the foundation of the modern Russian school. Borodin wrote his greatest compositions as recreation in the busiest period of his professional career and two of the best known of these, his third symphony and his opera *Prince Igor*, were unfinished at the time of his death. Both were capably completed by Glazounoff and Rimsky-Korsakoff and are often heard on the programs of the great symphony orchestras. Mr. Ormandy was especially fond of the Polevetsian Dances from *Prince Igor*.

So far as we have been able to discover, Borodin is the only physician in history who attained the highest rank in musical composition.

The one remaining example, and a very remarkable one, is that of Albert Schweitzer, who is still living. Educated originally for the ministry he had also studied organ music under com-

petent teachers and later graduated in medicine. He became the world's foremost exponent of the organ music of J. S. Bach and prepared for publication the most comprehensive and scholarly edition of Bach's preludes and fugues extant. Some years ago he betook himself to the west coast of French Equatorial Africa and established a medical mission at Lambaréné, about seventy miles inland, incidentally building and setting up there a large, modern organ. Wanderers in the dense, almost impassable, forests around there have reported their amazement at hearing the air suddenly filled with the tremendous majesty of a Bach fugue played by a master.

At intervals Schweitzer emerges from his voluntary exile to give organ recitals in London or on the continent. Always he is greeted by large and appreciative crowds of educated musicians who grasp eagerly the opportunity to hear him. He does this to raise money for his mission and he never returns empty-handed.

When one considers the exactions of the musical profession in order to reach the upper strata of perfection it is not surprising that so few have been able to accomplish its highest attainment while at the same time carrying on the work of any kind of medical practice or professional research. Borodin and Schweitzer, one the composer, the other the performer, stand alone in this distinction. G. C.

### Typhoid Mary

THE death last month of Typhoid Mary on North Brother Island in the East River, New York, recalls the incident of her detection as a typhoid carrier in 1907.

An outbreak of typhoid fever had occurred in a household at Oyster Bay in the late summer of 1906. In early 1907 Dr. George A. Soper was delegated to trace the source of the infection which involved six of the eleven persons in one household. All six cases had developed in one week's time with no other cases in the neighborhood. After excluding the usual sources of infection, the evidence developed that three weeks before the first case developed a new cook, Mary Mallon, had been employed and had departed three weeks after the typhoid had appeared. When finally located in 1907, she was employed as a cook for a family in New York City and two cases of typhoid fever occurred

in this family. One of the patients, the daughter of the employer, died of the disease. The cook refused to give information as to her past history, but the investigation disclosed that in seven of eight locations where she had been employed in the previous six years typhoid fever had developed a few weeks following her arrival and that she had left in each case a few weeks after the appearance of the disease. She had not contracted the disease at any of the discovered locations. She had been responsible for twenty-six cases with one death and doubtless many more which were not discovered.

Upon her refusal to be examined Typhoid Mary was forcibly taken into custody by the New York Department of Health, not however without a severe struggle. She was taken to the Detention Hospital where repeated examination of the feces proved her to be a typhoid carrier.

It had been shown that the gallbladder is the most frequent harbinger of typhoid bacilli in carriers, but Typhoid Mary refused operation. After several years she was released upon promising never to cook again. When this promise was broken she was again placed in detention for life.

It is reported that some two per cent of typhoid patients become carriers with the persistence of the infection in the gallbladder for months or even years following the acute fever. In 1908 Dean reported the case of an English doctor who twenty-nine years before had contracted typhoid fever in America and had had persisting gallbladder symptoms. Although the patient had carried on an active practice, he had not known of a case of typhoid fever for which he might have been responsible.

That a carrier of intestinal infection, especially one of low intelligence, little education and with no sense of responsibility, can be a menace to society was well illustrated in the case of Typhoid Mary. Her refusal to cooperate with authorities indicated a suspicion, at least, on her part that in some way she was responsible for the appearance of typhoid fever wherever she went. Her refusal to part with her gallbladder indicated an unusually long resisting stubbornness.

#### **The American Journal of Medical Jurisprudence**

ANOTHER medical journal, the *American Journal of Medical Jurisprudence*, was launched on its career with the appearance of its

first number in September, 1938. The tremendous increase in incidents in recent years that result in lawsuits involving medical practice is one of the reasons that such a journal is needed according to the first editorial by the editor, Dr. F. C. Warnshuis. It is believed that such a publication should be invaluable to the medical and dental professions, hospitals, druggist employers, employees, as well as attorneys! Subscription involves joining the American Medico-Legal Association with headquarters in Boston with a five dollar fee for registration and ten dollars annual dues which entitles the member to receive the journal monthly.

A perusal of the first issues of this new journalistic enterprise discloses an interesting array of articles involving various phases of medico-legal matters and the infant journal has our best wishes for a successful future. With the growth of the new journal's advertising section and a reduction in the subscription price we would predict a wider distribution.

#### **A Coördinated Medical and Public Health Program**

AT THE meeting of the House of Delegates of the American Medical Association in San Francisco last June a resolution embodying the so-called "Indiana Plan" was submitted.\*

The purpose of the plan is the extension of preventive medicine through an active campaign of education not only of the laity but of the medical profession itself. A topic is chosen each month and all agencies of state and county medical societies concentrate on that topic. If, for instance, pneumonia is the subject chosen for January, this subject would be stressed by the Public Health committees of state and county societies before parent teachers or similar associations, or over the radio or in syndicated newspaper articles, and the subject would also be stressed to the profession at county society meetings and in the current issue of the journal.

The plan is being submitted to the county societies by the office of the State Medical Association. If the plan receives a favorable response on the part of the membership, it is safe to say the various committees of the State Medical Association will cooperate wholeheartedly.

\*Plan in detail Journal of American Medical Association, 111:49, (July 2) 1938.

### A Motivating Force

"Consumption is a very fatal disease as it is at present managed. . . . The nineteenth century is drawing rapidly to a close. It has the honor of having discovered the cause and also of having defined the methods which are capable of exterminating this form of human suffering, and it should not be left to the next century to see them put into execution. From numerous small beginnings this reform will rapidly gain in volume and momentum, and it is destined to sweep with irresistible force over all obstacles, until in every civilized portion of the globe tuberculosis has bowed down to the majesty of preventive medicine."

**T**HUS wrote the late Dr. H. Longstreet Taylor of Minnesota, pioneer leader in the fight against tuberculosis, in the late nineties. However, it did remain for the next century to start the campaign of applying available knowledge to saving lives.

Strangely enough the motivating force was nothing more than a small scrap of paper, the tuberculosis Christmas Seal. This stamp, making every citizen a partner in the crusade, breaks through the wall of public indifference and brings the fight against tuberculosis close to the hearts of the people. It makes possible one of the most far-reaching health educational campaigns of all times. The fatalistic do-nothing attitude toward the great White Plague has given way to hope and action. Participation of citizens makes possible great victories.

Physicians have the aid of an aroused public in their efforts to set up machinery to fight tuberculosis. Sanatoria have made possible the isolation of spreaders of the disease. Intensive educational campaigns using all resources continue to create citizen interest and to disseminate information. The tuberculosis death rate has been halved and almost halved again. Definite programs of prevention and early discovery are in progress.

Of this program, Dr. Irvin Abell, Louisville, Kentucky, president of the American Medical Association, says:

"The splendid results achieved so far in the field of tuberculosis are gratifying, not alone to the profession, but to everyone interested in human welfare. The worthiness of the objective of the Christmas Seal Campaign is such as to appeal to the spirit of human kindness, which should be inherent in every individual, and consequently should have widespread endorsement. The National Tuberculosis Association, judged

by its aim and accomplishments, is an institution deserving any and all possible assistance."

The importance of continuing the program is indicated in the following statistics:

Tuberculosis is still the first cause of death during the age period from fifteen to forty-five, although it has been reduced to seventh in importance as a cause of death in the entire population.

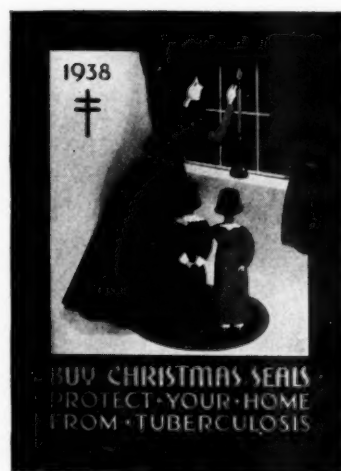
There are estimated to be more than 500,000 active cases of tuberculosis in the United States.

It is responsible for the death of 200 people every day, of one individual every seven and one-third minutes. Thirty years ago deaths occurred at the rate of one every three and one-half minutes.

Two-thirds of all the deaths from tuberculosis occur before the age of forty-five.

Considerably more than half of all the deaths from tuberculosis occur during the important productive years of life—between the ages of fifteen and forty-five.

Each year, tuberculosis claims the lives of forty thousand young people between the ages of fifteen and forty-five. In this state, the Minnesota Public Health Association, the affiliated unit of the National Tuberculosis Association, directs the state-wide sale of Christmas Seals.





# MEDICAL ECONOMICS

Edited by the Committee on Medical Economics  
of the

Minnesota State Medical Association

W. F. Braasch, M.D., Chairman

## THE A.M.A. IS INVESTIGATED

AN ARTICLE which was asserted to have been based on a thorough investigation of the American Medical Association appeared in the November issue of *Fortune*. The first portion includes a concise, if superficial, survey of some of the many activities of the American Medical Association. Unfortunately, the writer did not confine his observation to a thorough, impartial survey of the Association's numerous activities but went on to criticize the recent policies adopted by the Association and wound up with a plea for compulsory health insurance and medical reform. He used the stock arguments long employed by social reformers and included many of the statistical data which appeared in the National Health Report. He repeated the erroneous statement made by many lay observers that the policies of the American Medical Association are dictated by its officers. After all his investigation he failed to find out that the House of Delegates and constituent state societies are the predominant forces in the American Medical Association and not the officers.

### Misconceptions

Included among many misconceptions is the appraisal of Doctor Fishbein and his influence on American medicine. Doctor Fishbein is given credit for being the dictator of the policies and opinions of the Association. He is described as a promotor who has "promoted the Association from a mild academic body to a powerful trade association." To those of us who are familiar with conditions existing at the headquarters of the American Medical Association, such statements are ridiculous. According to the author, Doctor Fishbein is guilty of influencing the opinions of the members of the American Medical Association, and of leading their opposition to governmental control of medicine. The author apparently is ignorant of the

basic principles of the medical profession when he refers to the practice of medicine as a "Business Government Problem."

The writer states that the policies adopted by the officials of the American Medical Association are generally regarded as being unprogressive and antagonistic to reform. That the officers have been severely criticized by members of the Association and that their future leadership is now seriously threatened. While there may be many who believe this to be true, the great majority of the members of the A.M.A. are largely in agreement with its policies. It must be admitted that the officers of the Association and the Board of Trustees have been conservative in their attitude toward the many radical solutions of the economic problems of medicine which have been proposed in the last few years. If they had not been so, American medicine would be in a thoroughly demoralized state today. The officers have always faithfully carried out the policies adopted by the majority of the members of the House of Delegates and when a reform was suggested which proved to be sound, none were quicker to adopt it and to promote it.

### Survey Belittled

The article goes on to belittle the National Survey of Supply of Medical Service, which is being conducted by the physicians themselves. The absurd statement that the physicians cannot estimate the number of patients who have inadequate medical care as accurately as the door-bell surveys conducted by W.P.A. laymen sounds like a direct quotation from one of the medical proponents of medical socialization. References made to the advantages of a panel system of medical care are largely quotations from other superficial surveys made by American observers. The author apparently fails to realize the differences between the social conditions in Europe

and in America; the political control of our governmental activities and its lack of an adequate civil service; the greater demands and the better standards of living among those with low incomes in America—all of which would make a panel system of medical care impossible in this country.

While investigating the American Medical Association the writer apparently had one eye on the activities going on there and the other on the theories of a host of medical social reformers. Instead of a survey of the American Medical Association, the article is just another bit of lay propaganda by another social reformer. Although the writer's arguments for socialization contain nothing new, the veneer of authenticity given by a so-called investigator might well deceive the uninformed.

W. F. BRAASCH.

#### TIME TO PUSH FORWARD

Election results and an altered Congress will undoubtedly combine to retard somewhat new welfare programs that require huge expenditures of money.

Legislation to provide for vast new health services will probably be introduced into Congress; but experienced observers are of the opinion that appropriations to finance them will not be so easily secured as formerly.

It is unlikely that any state will seriously consider health legislation before Congress has had time to act.

If, in the meantime, organized medicine pushes forward in its program for local adjustment and improvement where it may be needed, for close and sympathetic coöperation with official agencies and for extension of those services to the needy wherever reliable studies have shown that they are needed, it is unlikely that any radical and unnecessary legislative program will gain support either in Washington or in the state legislatures.

#### Survey Essential

In any discussions on this issue the first essential will be reliable figures. Failing these, WPA collected figures of the United States Public Health Service's "Doorbell Survey," are sure to be quoted—and believed.

The Survey of Medical Needs and Supply initiated by the American Medical Association

and carried on in Minnesota by the Minnesota State Medical Association is designed to supply these figures.

Much information has already been gathered for this study but returns are still far from complete from the physicians themselves.

The importance of complete testimony from the doctors, themselves, has been repeatedly emphasized in these columns. Tabulations of all findings will be made in December. Members who have still not filled in Form No. 1 are urged to do so immediately and send them to the secretaries of their county societies.

#### ORGANIZED LABOR CONDEMNS SAINT PAUL CITY COUNCIL FIVE DOCTOR PLAN IN ACCIDENT CASES

The Saint Paul Trades and Labor Assembly has emphatically stated that it does not want any part of the plan concocted by Corporation Counsel John W. McConneloug and sponsored by Mayor William H. Fallon to deprive injured St. Paul city employes of their right under the laws of the State of Minnesota to choose their own physician, when injured in line of duty. Without a dissenting vote the Labor Assembly went on record as being opposed to the plan.

The resolution adopted by the Labor Assembly was presented by delegates of the Saint Paul Fire-Fighters' union. It called attention to the fact that the Ramsey County Medical Society had condemned the plan and that "city employes engaged in hazardous occupations are entitled to every protection of medical science." It also pointed out a well known truth "that personal confidence in one's physician is an important element in the treatment of any illness or injury." The resolution concluded by calling "upon the Labor members of the city council to demand a reconsideration of their action and to oppose adoption of any resolution calculated to destroy the right of any city employe to call his family physician for professional care in the event of any illness or injury suffered while in the performance of his official duties."

The Ramsey County Medical Society can well be proud that it took the initiative in condemning the plan and that it has the solid support of the Central Council of Public Service Employes and the Saint Paul Trades and Labor Assembly.

Every member of organized medicine should unite in preserving for these workers, and for themselves, the American principle of free choice of physician. This fight has just commenced and the importance of it will be more apparent as time passes. Right and justice will prevail even though there is a slight delay. Remember! Politicians come, and some politicians go, but the working man and the medical profession will be here for some little time.

### HORRIBLE EXAMPLE

In view of the crusading interest shown by many persons outside Washington, D. C., and the government in the welfare of the employes of the Home Owners Loan Corporation, it is particularly interesting to note that Group Health Insurance under the government subsidized plan has encountered nearly all of the difficulties inherent in contract practice during its two years of existence. These difficulties have nothing to do with differences between the association and the District of Columbia Medical Society.

The association started out bravely in 1937 offering full medical and hospital coverage for its members, wives and dependents, whether one or ten, for the sum of \$3.30 a month. By the time the first birthday had rolled around, however, all applicants were required to take a physical examination at a cost of \$5. If accepted each applicant was obliged to pay a \$10 initiation fee for himself and \$1 for each dependent in addition to the regular monthly payment. The monthly payment was also increased to \$4 a month for a man and his wife and \$1 extra for each minor child. There is a prospect, now, that the number of visits by the doctor may have to be minimized by a charge of \$1 additional cash for each visit.

At the end of 1937, therefore, the Washington Group Health Association, while serving as the pretext for widespread criticism of the medical profession is rapidly vindicating the attitude of organized medicine toward contract practice.

District of Columbia physicians may be supplied with an invaluable "horrible example" to justify their position. It should assist them materially in their own society-sponsored plans for the aid of low income groups in the capital.

### DENTISTS OPPOSE COMPULSORY CARE

The dentists of the United States joined the doctors in opposition to compulsory health insurance at their 80th annual meeting in St. Louis recently.

The following interesting recommendations by their special committee were adopted by the dental delegates at that meeting:

"We approve of the general expansion of public health services and, in addition, recommend the establishment of a Federal Department of Health with a secretary who shall be a graduate in medicine and a member of the President's Cabinet; and a first secretary who shall be a graduate in dentistry.

"In an expanded public health program which involves a consideration of the expenditure of millions of dollars for public health purposes, your Committee recommends that the problem of dental caries and other dental diseases be included.

"Your committee approves the proposed expansion of maternal and child health services provided that dental care of mothers and children be included.

"In any plan for extension of hospital facilities, your committee recommends that due consideration be given to inclusion of adequate facilities for dental services."

### "Satisfactory Care Cannot Be Rendered"

With reference to the proposals for provision of medical care for the medically needy and a general program of medical care the committee made the following recommendations:

"Your committee is convinced that satisfactory dental service cannot be rendered under a compulsory health insurance system. *We therefore do not favor such a plan but do approve voluntary budget plans under professional control which will enable patients to apportion costs and timing of payments so as to reduce the burdens of dental costs and remove the economic barriers which now militate against the receipt of adequate dental care.*

### Most Prevalent Disease

"The committee approves the recommendation that such a program should provide for continuing and increased incentives to the development and maintenance of high standards of professional preparation and professional service.

"In view of the fact that dental caries is the most prevalent disease of mankind, the American Dental Association strongly recommends that the Federal Government augment with a comprehensive research program the efforts of the organized dental profession to determine the cause of this disease."

### EXPERT MEDICAL TESTIMONY

Malpractice by a physician is predicated on the fact that there has been negligence on the part of such physician, and the size of the verdict awarded the plaintiff must be contingent on the evident results from such negligence. Negligence must be based again on what is proper treatment in the locality in which the injury was alleged to have been sustained and what the average, ordinary and reasonably prudent man would have done in a like situation.

Results in given cases must be sustained or denied by expert testimony. The question is often asked, "What is expert testimony in a malpractice case?"

Expert testimony may or may not be the testimony of a specialist or so-called "expert." It is the opinion of any person qualified by training and education to give such opinion on the facts of the case. This opinion should preferably be given by a qualified practitioner of medicine whose practice is in the same community as the defendant. He is certainly better able to testify as to the usual proceedings in that community than one whose place of business is much removed or who is in a different type of practice.

It has never been the opinion of the Medical Advisory Committee that one practitioner should conceal the facts concerning malpractice by another where negligence is evident. Members of our association should at all times protect each other, however, against the unscrupulous bringing of malpractice suits for the profit to be obtained either from the alleged negligent doctor or his insurance carrier.

In Minnesota the high quality of medical work performed and the evident interest in post-graduate training has given and will give to the people of this state less cause for litigation as time goes on. The year 1938 has shown this to your committee. We have high hopes for the coming year.

### WHY DO THEY DELAY?

A significant study of ten years' experience in the Massachusetts Cancer Clinics published recently in the *Journal of the American Medical Association* showed that a large percentage of persons who do not employ a physician fail to do so because they lack proper education rather than because they lack the funds.

Massachusetts has conducted free diagnostic cancer clinics for ten years. Free hospitalization is furnished the indigent and there is low cost hospitalization for those able to pay. Free pathological service is given and, since 1934, education based on the thesis that the local physician shall be instructor and first resource of his community, has been carried on.

Of 3,266 persons with chronic disease whose records indicate need of medical service, 878 did not have a physician during one year preceding the survey.

For every one of these who gave his economic status as a reason for delay 7.47 gave reasons such as fear, no faith in physicians, ignorance of seriousness of the condition, all of which pointed toward need for more information. Among the poor this ratio was reduced to 1 giving economic reasons to 2.46 needing education.

Even in Massachusetts, where economic needs are provided for, the problem of cancer delay is still acute.

### THE NEW DESPOTISM

The Lord Chief Justice of England, Lord Hewart, does not contemplate with equanimity the extension of government services in Great Britain. The following quotation from his book is evidence of that.

"In the kind of legislation which is being considered, it is usual to provide that the decision of the Minister shall be final and conclusive. When this is the case, the courts are powerless to intervene, however unjust and absurd a decision may appear to be. . . . It may be said that there is no substantial ground for the fear of unfairness or corruption in the Civil Service. . . . But if there is any great extension of the system of giving uncontrolled and arbitrary powers to public officials, it is as certain as that night follows day that corruption might creep in. We might then be cursed with the corrupt bureaucrat. The bureaucratic despot we already have.

"To take a simple instance, the treatment of panel doctors under the National Health Insurance Acts is pure despotism. The doctors are liable, at the mere discretion of the official who acts for the Minister of Health, to be ruined professionally by being struck off the panel or, as a lesser punishment, to be fined to an arbitrary extent. . . ."

The English Civil Service system is generally believed to be exempt from the distribution of political spoils.



It is doubtful if anyone in the United States could seriously suggest that here there would be no substantial ground for the fear of unfairness or corruption in the Civil Service.

## MINNESOTA STATE BOARD OF MEDICAL EXAMINERS

### License of Minneapolis Physician Suspended for Three Years

In the Matter of the Revocation of the License of Samuel R. Fraker, M.D.

The Minnesota State Board of Medical Examiners, at its regular meeting held on November 4, 1938, suspended, for three years, the license to practice medicine and surgery held by Samuel R. Fraker, M.D., Minneapolis. Dr. Fraker admitted his guilt before the Board of a charge of "procuring, aiding and abetting a criminal abortion." Dr. Fraker in his plea that his license be not revoked stated to the Board that he was retiring from the practice of medicine because of ill health.

Dr. Fraker was born in Pennsylvania in 1870 and graduated from the College of Physicians and Surgeons, Baltimore, in 1904.

### License of Red Wing Masseur Suspended

In the Matter of the Revocation of the License of Chris J. Bohmbach, Masseur.

Following a hearing held on November 4, 1938, the Minnesota State Board of Medical Examiners suspended, for a period of thirty days, the massage license held by Chris J. Bohmbach, Red Wing, Minnesota.

Mr. Bohmbach was charged with having represented himself to the public as a doctor, chiropractor and other designations whereas the laws of the state limit him to the term masseur. He was also charged with practicing chiropractic without being licensed.

At the hearing Bohmbach stated to the Board that he had removed from his office all signs, diplomas and other placards referring to him as a doctor or chiropractor. Bohmbach had twice previously been warned to remove these signs.

Evidence was also presented that Bohmbach's practice constituted the practice of chiropractic and not massage. He has been warned to keep within the provisions of the massage law or else further action will have to be taken.

### Minnesota License of New York Physician Revoked

In the Matter of the Revocation of the License of Norman W. Foster, M.D.

The Minnesota State Board of Medical Examiners on November 4, 1938, revoked the license to practice medicine and surgery held by Norman W. Foster, M.D., of Syracuse, New York. The evidence before the Board showed that Dr. Foster was convicted in the District Court of the United States for the Northern District of New York on October 19, 1937, of violating the Harrison Narcotic Law.

The indictment against Dr. Foster charged him with having sold, bartered, exchanged and given away 13,120  $\frac{1}{2}$  gr. morphine sulphate tablets and 840  $\frac{1}{2}$  gr. pantopon tablets to four patients during a period of five months.

Dr. Foster was born in New York in 1874 and grad-

uated from Syracuse University College of Medicine in 1898. He was licensed in Minnesota by examination in 1898. He resided in Saint Paul before returning to New York. His New York license was revoked in March, 1938.

### Hopkins Physician's License Revoked

In the Matter of the Revocation of the License of George W. Moore, M.D.

The license to practice medicine and surgery held by George W. Moore, M.D., Hopkins, Minnesota, was revoked by the Minnesota State Board of Medical Examiners on November 4, 1938. Dr. Moore was found guilty by the Board of "immoral, dishonorable and unprofessional conduct," and specifically with "procuring, aiding and abetting a criminal abortion."

Dr. Moore was before the Medical Board in 1936 on a similar charge and after being reprimanded was placed on probation. The facts show, however, that Dr. Moore continued in this type of criminal practice. Dr. Moore offered no defense at the hearing except to state that he did not "care to discuss the matter."

Dr. Moore was born in Indiana in 1870 and graduated in Medicine from the University of Minnesota in 1892.

### Physicians Licensed on November 4, 1938

#### October Examination

- Anderson, John Adolph, U. of Minn., M.B. 1933; M.D. 1934, St. Paul, Minn.
- Baker, Theodore, Jr., Jefferson Med. Col., M.D. 1933, Rochester, Minn.
- Basom, William Compere, Baylor U., M.D. 1936, Rochester, Minn.
- Becker, Arnetta Marie, U. of Minn., M.B. 1937; M.D. 1938, Minneapolis, Minn.
- Birge, Richard Fuller, U. of Neb., M.D. 1935, Rochester, Minn.
- Bodaski, Albert Alexander, U. of Minn., M.B. 1937; M.D. 1938, Minneapolis, Minn.
- Bond, John H., U. of Pa., M.D. 1936, Minneapolis, Minn.
- Church, John Mark, U. of Chicago, M.D. 1938, St. Paul, Minn.
- Cook, Paul Thomas, Northwestern U., M.B. 1937; M.D. 1938, St. Paul, Minn.
- Daniel, Ruby Kathryn, Baylor U., M.D. 1928, Rochester, Minn.
- Erskine, Gordon McClure, U. of Minn., M.B. 1937; M.D. 1938, Grand Rapids, Minn.
- Field, Anthony Hugh, Marquette U., M.D. 1938, Minneapolis, Minn.
- Fisk, Charlotte, U. of Iowa, M.D. 1932, Minneapolis, Minn.
- Gardner, John Williams, U. of Ore., M.D. 1936, Rochester, Minn.
- Grinley, Andrew Victor, Rush Med. Col., M.D. 1937, St. Paul, Minn.
- Hammerel, John Joseph, Loyola U., M.D. 1938, St. Paul, Minn.
- Henderson, John Warren, U. of Neb., M.D. 1937, Rochester, Minn.
- Hertz, Myron Jacob, U. of Minn., M.B. 1938, St. Paul, Minn.
- Ide, Lucien Waterman, U. of Iowa, M.D. 1937, St. Paul, Minn.
- Karn, Jacob Francis, U. of Minn., M.B. 1938, Minneapolis, Minn.
- Kaufmann, Mark Irving Herbert, McGill U., M.D. 1936, Oak Terrace, Minn.
- Keating, Francis Raymond, Jr., Cornell U., M.D. 1936, Rochester, Minn.

King, William Lyon Mackenzie, U. of Toronto, M.D. 1937, Rochester, Minn.  
 Lander, Howard Hayes, Northwestern U., M.D. 1937, Rochester, Minn.  
 McKelvey, John L., Queen's U., M.D., C.M. 1926, Minneapolis, Minn.  
 McManamy, Eugene Patrick, McGill U., M.D. 1936, Rochester, Minn.  
 Morissette, Leopold, U. of Montreal, M.D. 1936, Rochester, Minn.  
 Mountain, George Elmer, Northwestern U., M.D. 1938, Rochester, Minn.  
 Nelson, Edward Norman, U. of Cincinnati, M.B. 1938, Minneapolis, Minn.  
 Novak, Milan Vaclav, U. of Minn., M.B. 1938; M.D. 1938, Minneapolis, Minn.  
 Peterson, Lowell John, U. of Minn., M.B. 1937, Minneapolis, Minn.  
 Pugh, David Graham, U. of Ind., M.D. 1932, Rochester, Minn.  
 Ramsay, Robert Matthews, U. of Manitoba, M.D. 1937, St. Paul, Minn.  
 Sather, Richard Norman, Rush Med. Col., M.D., 1937, St. Paul, Minn.  
 Seebach, Leslie G., U. of Minn., M.B. 1938, Minneapolis, Minn.  
 Sherman, Lloyd Frederick, U. of Minn., M.B. 1938, Minneapolis, Minn.  
 Sims, John LeRoy, U. of Texas, M.D. 1937, St. Paul, Minn.  
 Smith, Graham Gable, U. of Minn., M.B. 1938, Minneapolis, Minn.  
 Smith, Robert Lee, Jr., Stanford U., M.D. 1937, Rochester, Minn.  
 Stafford, Donald Edward, Harvard U., M.D., 1935, Rochester, Minn.  
 Stewart, Donald Edward, U. of Minn., M.B. 1937; M.D. 1938, Minneapolis, Minn.  
 Street, Bernard, U. of Minn., M.B. 1937, Minneapolis, Minn.  
 Utendorfer, Robert William, Northwestern, M.B. 1937; M.D. 1938, St. Paul, Minn.  
 Vadheim, James Lowell, U. of Minn., M.B. 1937, Minneapolis, Minn.  
 Vickers, Evelyn Smith, U. of Minn., M.B. 1936; M.D. 1937, St. Paul, Minn.  
 Walsh, William Vincent, U. of Minn., M.B. 1937; M.D. 1938, Minneapolis, Minn.  
 Westra, Jacob John, Rush Med. Col., M.D. 1937; Rochester, Minn.  
 Word, Harlan Lamar, U. of Okla., M.D. 1936, St. Paul, Minn.  
 Wulf, Robert Fischer, U. of Pa., M.D., 1936, Rochester, Minn.

*By Reciprocity*

Baumeister, Carl Frederick, U. of Iowa, M.D. 1933, Council Bluffs, Ia.  
 Frost, John Bert, U. of Wis., M.D., 1937, Minneapolis, Minn.  
 Gore, Herbert Robert, Long Island Medical Col., M.D. 1933, Rochester, Minn.  
 Settlege, Arnold Frederick Ernest, Harvard U., M.D. 1933, Worthington, Minn.  
 Walske, Benedict Raymond, Marquette U., M.D. 1937, Galesville, Wis.

*National Board Credentials*

Kenyon, Thomas Jackson, U. of Minn., M.D. 1938, St. Paul, Minn.  
 Reeser, Richard, Jr., Cornell U., M.D. 1935, Rochester, Minn.  
 Sundet, Nere Joseph, U. of Minn., M.B. 1936; M.D. 1937, Gary (Norman Co.), Minn.  
 Vinje, Ralph, Northwestern U., M.D. 1936, Bismarck, N. Dak.

## OF GENERAL INTEREST

Dr. Owen W. Parker of Ely was elected president of the Minnesota State Sanitary Conference at its last meeting.

\* \* \*

Dr. H. T. Sherman, formerly of Plainview, has moved to Spring Valley, where he will continue the practice of medicine.

\* \* \*

Dr. Gordon Erskine has become associated with Dr. H. E. Binet, Grand Rapids. Dr. Erskine was formerly located in Minneapolis.

\* \* \*

Dr. James R. Deagen, formerly of Cold Spring, has established an office in Freeport, where he will continue the practice of medicine.

\* \* \*

The engagement has been announced of Eleanor Mary Smith, St. Paul, to Dr. Clarence Dennis, St. Paul, son of Mrs. Warren A. Dennis and the late Dr. Dennis.

\* \* \*

Dr. F. W. Engdahl, formerly associated with Dr. H. E. Binet at Grand Rapids, has moved to Ortonville, where he will continue the practice of medicine.

\* \* \*

Dr. S. Sandell, formerly of Grand Rapids, is taking over the practice of Dr. A. M. Boe of Deer River, who is leaving Deer River because of ill health.

\* \* \*

The Minnesota-Dakota Orthopedic Club met in Rochester on October 22. Several interesting papers were presented in the morning, followed by a luncheon.

\* \* \*

Dr. Traugott Bloedell of Thief River Falls was married to Miss Marion Bernice Long of Minneapolis, on November 9. Dr. Bloedell is on the staff of the Bratrud Clinic.

\* \* \*

Dr. Ralph Vinje of Bismarck, North Dakota, formerly a member of the Roan and Strauss Medical Clinic of Bismarck, has located at Ada for the general practice of medicine. He is a son of Dr. and Mrs. Syver Vinje of Hillsboro, North Dakota.

\* \* \*

Dr. Charles B. Cunningham, obstetrician and gynecologist, has become associated with the Lenon-Peter-

## OF GENERAL INTEREST

son Clinic in Virginia. Dr. Cunningham was formerly associated with the Harper Hospital at Detroit, Michigan.

\* \* \*

The Minnesota Radiological Society held a meeting in Rochester on October 22. A number of interesting papers were presented in the afternoon. Dr. W. C. MacCarty was the speaker at the informal dinner at the Kahler Hotel.

\* \* \*

Dr. H. W. Arndt of Detroit Lakes has been elected president of a newly organized hospital staff at the St. James Hospital, Perham. Under the new organization no contract surgery will be permitted, it has been announced.

\* \* \*

Dr. O. E. Snyder has located in Virginia for the practice of medicine. He is a graduate of the University of Minnesota and Loyola University of Chicago. He served his internship at Ancker Hospital in Saint Paul, and was house physician at the Midway Hospital in Saint Paul.

\* \* \*

Dr. Robert H. La Bree has succeeded Dr. W. J. Gillesby as resident surgeon at the Rood Hospital in Chisholm. Dr. La Bree is a graduate of the University of Minnesota, and served his internship at the Minneapolis General Hospital. He has also been attending surgeon at the state hospital at Fergus Falls.

\* \* \*

Dr. L. J. Hoyer, formerly of Howard Lake, has moved to Windom. Dr. Hoyer spent most of July, August and September at the Cook County Post Graduate School in Chicago, giving special attention to the subjects of major surgery and fractures. Dr. Hoyer's practice at Howard Lake has been taken over by Dr. R. H. Rolig.

\* \* \*

Dr. Hugh Cabot, consulting surgeon at the Mayo Clinic since 1930, was married at Hingham, Massachusetts, on October 8, to Mrs. Elizabeth Cole Amory. Dr. Cabot left Rochester, September 28, for his former home near Boston, on an indefinite leave of absence, and it is reported he plans to resign his position at the Clinic and live at Hingham.

\* \* \*

Dr. Walter H. Judd, medical missionary from China, son of Dr. E. Starr Judd, has been appearing in a number of educational lectures regarding the United States' relation to China and Japan. He is an effective speaker, and is in a position to know the developments in north China, having been located in North China from 1934 to 1938. Dr. Judd expects to return to China at a later date.

\* \* \*

Dr. F. L. Jennings, assistant superintendent and medical director of Glen Lake Sanatorium, has gone to Indianapolis, Indiana, where he will be superintendent

of the Sunnyside Sanatorium. Dr. Jennings was associated with Glen Lake Sanatorium for more than twenty years, and has been a member of the Board of Directors of the Hennepin County Tuberculosis Association, where he has taken an active part in the program for tuberculosis control in Hennepin County.

\* \* \*

Dr. Gilbert J. Thomas has returned from Houston, Texas, where he was a guest speaker at the Seventh Annual Postgraduate Medical Assembly of South Texas, held November 1, 2 and 3. Dr. Thomas spoke on the following subjects: "Non-Specific Renal Infection"; "Chronic Infection of the Prostate Glands; Their Relation to Other Foci of Infection"; "Sterility in the Male and the Responsibility of the General Practitioner in the Diagnosis and Treatment"; "Tuberculosis of the Genital Tract."

Dr. Thomas also spoke to the students at Baylor University by special request, on the subject of "Tuberculosis of the Kidney."

\* \* \*

The detailed plans for the emergency care of visitors to the New York World's Fair include an automobile x-ray unit available to the eight first aid stations to be established on the grounds. X-rays will be taken and developed at once, not only in cases of severe injury, but where fracture is only suspected. It is estimated that such procedure will minimize the fake claims against the Fair itself or exhibitors. First aid in the form of oxygen for resuscitation will also be available in cases of asphyxiation from whatever cause, and inhalation anesthesia for emergency operations. According to estimates, some eighteen to twenty deliveries are likely to take place during the course of the fair.

\* \* \*

The increasing demand for graduate training in the various fields of medicine is evidenced by the following tabulation of the graduate students in the Medical School of the University of Minnesota. This is exclusive of those who are registered under the Mayo Foundation division of the Graduate School.

The total number of candidates for graduate degrees in the fall of 1938 was 166. These are divided as follows:

I. Candidates for Doctor of Philosophy degrees: anatomy, 4; bacteriology, 12; internal medicine, 2; neuropsychiatry, 1; obstetrics and gynecology, 7; ophthalmology and otolaryngology, 1; pediatrics, 6; pharmacology, 3; general physiology, 9; physiological chemistry, 5; general preventive medicine and public health, 1; biostatistics, 1; surgery, 7; and radiology, 5.

II. Candidates for Master's degrees: anatomy, 14; bacteriology, 16; internal medicine, 5; neuropsychiatry, 2; dermatology, 2; ophthalmology and otolaryngology, 12; pathology, 8; pediatrics, 1; pharmacology, 1; general physiology, 12; physiological chemistry, 7; general preventive medicine and public health, 11; biostatistics, 2; surgery, 6; and radiology, 3.

## In Memoriam

### Leo Melville Crafts

1863-1938

**D**R. LEO MELVILLE CRAFTS was born in the City of Minneapolis in 1863, the son of Major Amasa and Mary J. Crafts. Some of his ancestors were among the founders of Boston and his parents early pioneers of Minneapolis.

Dr. Crafts was educated in the public schools of Minneapolis and graduated from the law department of the University of Minnesota in 1886 and from Harvard Medical School in 1890. He interned at the Boston City Hospital and also served there for one year as house physician.

He began the practice of his specialty in Minneapolis in the early nineties, serving as professor of Nervous and Mental Diseases in the Medical Department of Hamline University from 1893 to 1908, being Dean of the faculty from 1893 to 1903.

Dr. Crafts was a member of the staffs of most of the leading hospitals in Minneapolis and enjoyed a very large consulting practice. He was treasurer of the Hennepin County Medical Society for two years.

Dr. Crafts belonged to the Hennepin County Medical society, the Minnesota State and American Medical associations, the Massachusetts Medical society, the Harvard Medical and Boston Alumni associations.

He was a member of the First Congregational Church of Minneapolis for fifty-five years, being active in the Minnesota State Sunday School Association, serving as its president for three years. He was a member of the board of directors of the Minnesota National Park and Forestry Association, the old Minneapolis Commercial Club, the Auto Club, the American Legion and the Bloomington Golf Club. He also belonged to the Republican Party, the Sons of the American Revolution, Phi Rho Sigma, and Native Sons of Minnesota.

Dr. Crafts served during the war at Camp Funston and later with the United States Veterans' Bureau at Minneapolis.

On September 4, 1901 he married Amelia I. Burgess, who survives him.

Dr. Crafts practiced neurology in Minneapolis for almost half a century, and was at work in his office when he died on September 22, 1938, at the age of seventy-five.

Dr. Crafts came into the practice of his specialty well prepared. Few men of his time had his educational background. He was a gifted teacher who was able to impart enthusiasm as well as instruction to his students. He personified the highest ideals of medical ethics. As Dean of the medical department of Hamline University he gave a great leadership to his students and to his fellow faculty members as well. Dr. Crafts enjoyed a long and useful practice, being one of the most helpful consultants in his special field.

Dr. Crafts' kindly manner, courteous treatment of

others, his ample knowledge and his unlimited charity endeared him to his patients and his fellow doctors.

Following is a list of Dr. Crafts' contributions to medical literature:

1. Relation of Spinal Concussion to Chronic Diseases of the Spinal Cord, 1892.
2. The Sensory Manifestations of Hysteria, 1893.
3. Medical Education, 1898.
4. The Physician in Practice, 1898.
5. A Fifth Case of Family Periodic Paralysis, 1900.
6. Incipient Amyotrophic Lateral Sclerosis with Recovery, 1902.
7. Wear and Care of the Nervous System, 1906.
8. Nerve Stress and Longevity, 1906.
9. The Influence of Ductless Glands Over Metabolism, 1908.
10. Expert Testimony and The Medical Witness, 1909.
11. Mechanism and the Significance of the Reflexes, 1910.
12. The Problem of the Insane and the Defective, 1910.
13. Symptomatology of Traumatic Organic Lesions Affecting Sensorimotor Areas, 1912.
14. Possibilities in the Treatment of Epilepsy, 1915.
15. Myasthenia Gravis with Report of Three Cases, 1917.
16. The Early Recognition of Multiple Sclerosis, 1917.
17. An Original Test for the Pathologic Great Toe Sign, 1919.
18. Mixed Cell Sarcoma of the Brain, 1922.
19. Epidemic Encephalitis: Some of the More Unusual of Its Widely Variant Syndromes, 1923.
20. Text Book on Epidemic Encephalitis, 1927.
21. Reflections on Sexology, 1936.

CLAUDE C. KENNEDY.

### Raymond W. Lagerson

1896-1938

**D**R. RAYMOND W. LAGERSON, a practicing physician in Minneapolis for the past fifteen years, died at the University Hospital, March 13, 1938, following a cerebral hemorrhage.

Dr. Lagerson was born November 19, 1896, at Burns, Minnesota. He graduated from the high school at Anoka in 1915 and received his medical degree from the University of Minnesota Medical School.

A member of the staff of St. Barnabas Hospital for a number of years, he was also a member of the Hennepin County Medical Society, state and national medical associations.

Dr. Lagerson is survived by a daughter, Diane, a brother Leif Lagerson of Milwaukee, and five sisters, Mrs. Joseph Peterson, Mrs. Phil Peterson and Mrs. Earl Hunter of Anoka, Mrs. Frank Addington of Saint Paul, and Mrs. L. H. Nolte of Seattle.

### Peter Lorentz Vistaunet

1871-1938

**D**R. P. L. VISTAUNET, one of the most prominent physicians of Thief River Falls, died on September 22, 1938, from pneumonia.

Dr. Vistaunet was born February 7, 1871, at Inneroi, near Trondhjem, Norway. At the age of seventeen he came to America and received his M.D. degree from the University of Minnesota Medical School in 1902.

On June 27, 1903, Dr. Vistaunet was married to Anna C. Hauglum. His wife and one son, Alv, and daughter, Liv, survive him.

Dr. Vistaunet was city health commissioner for several years. He was a member of the I.O.O.F., W.O.W. and Sons of Norway lodges. An able musician, he served as assistant leader of the Red River Scandinavian Singers' Association and directed the local Brage Chorus for many years. He was choir director in the Trinity Lutheran Church for about twenty years.

MINNESOTA MEDICINE



## REPORTS and ANNOUNCEMENTS

### MEDICAL BROADCAST FOR DECEMBER

The Minnesota State Medical Association Morning Health Service.

The Minnesota State Medical Association broadcasts weekly at 11:00 o'clock every Saturday morning over Station WCCO, Minneapolis (810 kilocycles or 370.2 meters) and Station WLB, University of Minnesota (760 kilocycles or 395 meters).

*Speaker:* William A. O'Brien, M.D., Associate Professor of Pathology and Preventive Medicine, Medical School, University of Minnesota. The program for the month will be as follows:

December 3—Occupational Skin Disease.

December 10—Tuberculosis.

December 17—Irritable Colon.

December 24—Medical Accomplishments.

December 31—New Year Resolutions.

### E. STARR JUDD LECTURE

Dr. Dallas B. Phemister of Chicago, Illinois, Professor and Chairman of the Department of Surgery at the University of Chicago, will give the sixth E. Starr Judd Lecture at the University of Minnesota in the Medical Science Amphitheater on Wednesday, February 1, at 8:15 P. M. The subject of Dr. Phemister's lecture is "Pathogenesis of Gallstones." The late E. Starr Judd, an alumnus of the Medical School of the University of Minnesota, established this annual lectureship in surgery a few years before his death.

### MINNESOTA PUBLIC HEALTH ASSOCIATION

In observance of the twentieth anniversary of the completion of Minnesota's chain of public tuberculosis sanatoria, the Minnesota Public Health Association dedicated its annual meeting, held November 18, in the Twin Cities, to the surviving original board members of each institution. Principal speakers were Dr. W. W. Bauer, Director of the Bureau of Health and Public Instruction of the American Medical Association, Chicago, and Dr. H. E. Hilleboe, Director, Divisions of Tuberculosis and Services for Crippled Children, Minnesota State Board of Control.

Dr. S. A. Slater, Worthington, President of the Association, presented the following pioneer sanatorium board members with life certificates in the organization: Dr. E. L. Tuohy, Duluth, of Nopeming Sanatorium, St. Louis County, the first county institution in the state, established in 1912; Mrs. W. J. O'Toole, Mrs. L. P. Wolff, Mrs. Claude S. Brown and Mr. James C. Otis, all of St. Paul, Ramsey County Preventorium established in 1915; Mr. L. E. Johnson, Wanamingo, and Mr. M. W. Smith of Red Wing, Mineral Springs Sanatorium established in 1915; Mr. Edward C. Gale

and Mr. Joseph R. Kingman, Minneapolis, of Glen Lake Sanatorium, established in 1916; Mr. J. L. Wold, Thief River Falls, of Sunnyrest Sanatorium, established in 1916; Dr. E. W. Johnson, Mr. A. P. Ritchie and Mr. A. A. Tone, all of Bemidji, Lake Julia Sanatorium, established in 1916; Dr. C. L. Sherman, Luverne, Dr. A. L. Vadheim, Tyler, L. F. Johnson, Mankato, Dr. Thomas Lowe, Pipestone, G. S. Redmond, Pipestone, N. P. Minion, Bingham Lake, H. M. Burnham, Jackson, S. S. Smith, Worthington, of Southwestern Minnesota Sanatorium, established in 1917; Mr. E. W. Davis, Detroit Lakes, Dr. O. J. Hagen, Moorhead, Mr. John Nelson, Lake Park, of Sand Beach Sanatorium, established in 1917; Mr. L. Engstrom, Roseau, Donald Robertson, Argyle, and Dr. O. F. Mellby, Thief River Falls, of Oakland Park Sanatorium, established in 1918; Dr. W. W. Will, Bertha, of Fair Oaks Lodge Sanatorium, established in 1918; Dr. J. A. Thabes, Brainerd, Charles P. Delaittre, Aitkin, and Mr. Peter Larson, Aitkin, of Deerwood Sanatorium, established in 1918.

Dr. Hilleboe summarized the progress made in Minnesota during its sanatorium and anti-tuberculosis campaign and the problem ahead in the following words:

"Since the establishment of Pokegama Sanatorium at Pokegama, Minnesota, in 1905, and the Minnesota State Sanatorium at Ah-Gwah-Ching, Minnesota, in 1907, with the capacity of sixty beds, farsighted county and state officials, public spirited citizens, and physicians have continued to develop the sanatorium program with the result that at the present time there are fourteen county sanatoria, one county preventorium, and one state sanatorium, with the total capacity of 2,254 beds available for the care of the tuberculous. In 1937 there were 912 deaths from tuberculosis. This means that there are more than two sanatorium beds available for each death from tuberculosis in any one year in Minnesota at the present time.

"With the establishment of adequate sanatoria beds for care of tuberculous patients in need of hospitalization, our program is being directed in two other fields of endeavor. First, it is essential for control of the disease to diagnose early cases of tuberculosis so that the best possible chance of arrest of the disease may be obtained. After an adequate period of sanatorium care, another important factor in the control of tuberculosis is being developed in after-care and rehabilitation of tuberculous patients. It is necessary to provide the necessities of life, medical supervision, and relief from mental anxiety for tuberculous patients discharged from sanatoria, particularly during the first five years after discharge, if best results are to be obtained. The needs of the tuberculous in Minnesota can be met only if a strong battle is waged against this dread disease along these three fronts."

### CAMP RELEASE DISTRICT

At the meeting of the Camp Release District Medical Society, held on October 20, 1938, the following officers were elected for the coming year: H. A. Roust, Montevideo, president; George Tangen, Canby, vice president; Magnus Westby, Madison, secretary-treasurer.

The following members were elected to the Advisory Committee: M. Hauge, Clarkfield; George Boddy, Jr., Dawson; F. M. Burns, Milan; H. L. Herbert, Granite Falls; N. Westby, Madison; L. G. Smith, Montevideo.

The society held a meeting at Montevideo on November 3. Dr. Frederick H. K. Schaaf of Minneapolis spoke on "Cardiac Disorders."

#### EAST CENTRAL MINNESOTA

The East Central Minnesota Medical Society held a dinner and inter-professional meeting at the Episcopal Parish House in Anoka, Minnesota, on October 11, 1938. Problems common to the allied professions of medicine, law, dentistry, and pharmacy were discussed by guest speakers.

Guests of the Society were Dr. Wm. Dickson of Minneapolis, Vice-Chairman of the Legislative Committee of the State Dental Association; Dr. B. J. Branton, Willmar; Mr. H. H. Gregg, Minneapolis; Dr. F. J. Savage, St. Paul; and Mr. R. R. Rosell, Executive Secretary of the State Medical Association.

#### MOWER COUNTY

Newly elected officers of the Mower County Medical Society are: R. S. Hegge, Austin, president; J. M. Thomson, Brownsdale, vice president; Paul A. Robertson, Austin, secretary; A. E. Henslin, Le Roy, treasurer.

#### RICE COUNTY

At the meeting of the Rice County Medical Society, held in Faribault, November 3, Dr. Gordon R. Kamman of Saint Paul was the guest speaker. His subject was "Endemic Encephalitis."

#### SOUTHWESTERN MINNESOTA

The annual meeting of the Southwestern Minnesota Medical Society was held in Worthington on October 31. Doctors from six counties gathered for dinner and heard Dr. William A. O'Brien speak on "Socialized Medicine." Dr. J. D. Waller of Wilmont was elected president; Dr. B. M. Stephenson of Fulda, vice president; Dr. J. De Boer of Edgerton, secretary-treasurer; Dr. E. W. Arnold of Adrian, censor from Nobles County.

The members of the Woman's Auxiliary of the Society were present at the dinner, and were entertained afterward by Mrs. C. R. Stanley.

#### STEARNS-BENTON COUNTIES

The Stearns-Benton Medical Society held its monthly meeting in St. Cloud on November 17. Dr. W. W. Bill of Bertha, and Dr. E. J. Simons of Swanville, were the principal speakers.

### WOMAN'S AUXILIARY

Mrs. W. B. Roberts, President  
2735 Irving Avenue South, Minneapolis.  
Mrs. E. V. Goltz, Press and Publicity, St. Paul, Minn.

The members of the Women's Auxiliary of the Hennepin County Medical Society, held their regular meeting Friday, November 4, in the Hennepin County Medical Library. On November 18 and 19 they sponsored the annual sale of articles made by the patients of Glen Lake Sanatorium, the proceeds going to the makers of the articles. The sale was under the leadership of Mrs. J. C. Davis, chairman, and Mmes. N. F. Lufkin, L. F. Richdorf, J. C. Miller, L. M. Larson, F. L. Jennings and Donald McCarthy.

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The members of the Women's Auxiliary of the Scott Carver Medical Society held their first meeting of the season on October 11 at Montgomery, Minnesota. After having dinner with their husbands they met at the home of Mrs. Alvin Westerman and discussed plans for the year. The new officers are: Mrs. B. F. Pearson, Shakopee, president; Mrs. H. P. Fischer, Shakopee, vice president; Mrs. H. M. Juergins, Belle Plaine, secretary and treasurer.

\* \* \*

The members of the Ramsey County Auxiliary held their first meeting of the fall in the Medical Society rooms in the Lowry Building, Monday, October 24. Mrs. A. E. Nichols, president, presided. During the afternoon a reading was given by Mrs. Roy Jones of Minneapolis. Members of the board for the coming year are: Mrs. A. E. Nichols, President; Mrs. Harry Ghent, president-elect; Mrs. Hugh Beals, vice president; Mrs. Charles Waas, recording secretary; Mrs. Mark Ryan, treasurer; Mrs. E. H. Boland, auditor; Mrs. E. C. Eshelby, parliamentarian; Mrs. Albert Schulze, historian; Mrs. B. J. Mears, magazine; Mrs. Herman Kesting, information; Mrs. Richard Aurelius, Christmas seals; Mrs. C. Neumann McCloud, hospitality; Mrs. Karl Wold, philanthropic; Mrs. Lloyd G. Dack, program; Mrs. Douglas Brand, year book; Mrs. Gordon R. Kamman, publicity; and Mrs. James Benepe, ways and means.

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Mrs. Wm. B. Roberts, president of the Women's Auxiliary of the Minnesota State Medical Association, returned November 13 from an extensive trip in the East.

#### Oddities Called for in Drug Stores

Sterilized Ink for Stearate of Zinc.  
Hyena Nursing Bottle for Hygeia Bottle.  
Paralyzed Gauze for Sterilized Gauze.  
Aspiration Tablets for Aspirin Tablets.  
Polluted Water for Pluto Water.  
Scott's Emotion for Scott's Emulsion.  
Rooster Foam for Hennafoam.  
Runaway Seeds for Caraway Seeds.  
Cynical for Clinical Thermometer.  
Exorbitant for Absorbent Cotton.

## PROCEEDINGS OF THE MINNESOTA ACADEMY OF MEDICINE

Meeting of October 12, 1938.

The regular monthly meeting of the Minnesota Academy of Medicine was held at the Town and Country Club on Wednesday evening, October 12, 1938. Dinner was served at 7 o'clock and the meeting was called to order at 8 o'clock by the President, Dr. R. T. LaVake.

There were fifty-six members and one guest present. Minutes of the May meeting were read and approved as read.

The Secretary read a letter of resignation from Dr. George E. Senkler, with the recommendation from the Executive Committee that his name be placed on the Honorary Membership list. A motion was seconded and unanimously carried that this be done.

The Secretary introduced a proposed amendment to Article III, Section I of the Constitution to read as follows: "There may also be *ten* active members from the University faculty who are teachers of medicine not engaged in private practice." This had been approved by the Executive Committee and will be printed on the November programs. The Executive Committee also suggested the election of new members at the December meeting.

The Secretary was instructed to write a letter of appreciation to Dr. Archa Wilcox for the party held at Dr. Wilcox's summer home in July.

The scientific program followed.

### PRIMARY CARCINOMA OF THE PANCREAS

JUSTUS OHAGE, M.D.

Dr. Ohage, of St. Paul, read his Inaugural Thesis on the above subject. (To appear in MINNESOTA MEDICINE at a later date.)

#### Abstract

A series of thirty-nine cases of primary carcinoma of the pancreas, proved by autopsy or operation, were reviewed.

Primary carcinoma of the pancreas is most common in the fifth and sixth decades; the average age of incidence in this series was sixty-one years. It is more common in males than in females; the ratio in this series was 2.5 to 1. The head of the pancreas is most commonly involved; only the head was involved in almost 60 per cent of the cases in this series.

The diagnosis of primary carcinoma of the pancreas is largely by exclusion. Most commonly it must be differentiated from stone in the common duct. For this purpose, the Watson test is very useful.

Negative x-ray findings in the stomach and duodenum are also of great value as diagnostic aids.

Jaundice should not be considered as a cardinal symptom. At least four, and possibly seven, cases in this series had no jaundice and no involvement of the common duct.

The prognosis is grave but by no means hopeless. Surgical intervention is the best palliative means. Cho-

lecystoduodenostomy and cholecystojejunostomy are the operations of choice.

#### Discussion

DR. IRVINE MCQUARRIE (U. of M.): Do these malignant tumors ever originate from the Islands of Langerhans?

DR. OHAGE: Very rarely. Malignant tumors of the pancreas nearly always originate from the ducts of the gland or the parenchyma.

DR. MAX HOFFMAN (St. Paul): Dr. Ohage stated that five of the cases presented showed positive blood findings in the stool. I am impressed with the fact that in carcinoma of the head of the pancreas blood is frequently found in the stool, and it is a valuable diagnostic finding. I would like to ask Dr. Ohage if stools were examined in the entire series? Contrary to the textbook description of carcinoma of the head of the pancreas, intermittent jaundice is not rare, especially in the early states, and the presence of intermittent jaundice should not lead one away from the true diagnosis.

DR. OHAGE: Unfortunately, all of our cases did not have stool analysis and consequently I was unable to determine the exact percentage of cases which showed blood in the stool. In our series, five cases showed blood and absence of bile.

DR. MOSES BARRON (Minneapolis): Dr. Ohage stated that jaundice is not a constant finding in his series of cases. However, it is obvious that the jaundice is important in diagnosing carcinoma of the pancreas only when the tumor is in the region of the head of the organ. In a number of his cases the involvement was in the body and tail, and of course jaundice is of little importance when in these regions. Dr. Hoffman brought out the fact that occasionally there is an intermittency in the jaundice. That is true. Occasionally there develops collateral inflammatory edema as a result of the growth of these tumors. When the edema is present the bile ducts may be compressed, with jaundice resulting. When the edema subsides the ducts may reopen, and the jaundice may disappear. One cannot say dogmatically that because there is intermittency the jaundice is not the result of a tumor in the head of the pancreas.

DR. HENRY L. ULRICH (Minneapolis): I recall a case of carcinoma of the tail of the pancreas. All the symptoms were pleural. There were repeated effusions in the left chest which, as they progressed, became more and more mucoid in character. Not until the post-mortem did we realize what we were dealing with. A primary carcinoma of the tail had walked up through the spleen and then the diaphragm and had involved the left pleura.

DR. OHAGE: In answer to Dr. Barron's discussion,

jaundice is practically always present in carcinoma of the head of the pancreas except in anomalous conditions, as in one case where the common duct passed completely over the head of the pancreas. If there is no involvement of the common duct by compression or extension of the malignant process, jaundice does not take place. Dr. Ulrich cited a case of carcinoma of the tail of the pancreas in which case the malignancy extended through the diaphragm into the lung. The patient showed no jaundice.

### NAILING OF HIP FRACTURES

WALLACE COLE, M.D.

Dr. Cole, of St. Paul, reported on this method of operation in hip fractures, and showed lantern slides.

#### Discussion

DR. E. A. REGNIER (Minneapolis): I wish to compliment Dr. Cole on this report of his method of nailing intracapsular hip fractures. Those of us who have taken an interest in this type of work have been bewildered by the numerous gadgets which have been devised. I have had the opportunity of seeing Dr. Cole's instrument used by his colleagues and I am frank to state that it is the best that I have seen.

While the conservative method of treatment recommended by Whitman is still usable and good in well-trained hands, I believe that the day is not far away when all these intracapsular fractures will be treated immediately by internal fixation. We now have evidence that the treatment by internal fixation will be attended by a high percentage of excellent results.

There are three or four factors, as Dr. Cole has stated, which recommend internal fixation. The first and most important of these is the immediate relief of pain, doing away with long periods of bed rest and sedation by the use of opiates. The second factor is the great economic saving to the patient both in money and period of disability. The third factor is that it obviates a prolonged period of rehabilitation of the patient due to prolonged incarceration in plaster. All these factors, assuming that an accurate reduction was obtained and the fixation was maintained, insure a bony union.

I have had a limited experience in nailing hip fractures by the direct exposure method. I have, in most instances, chosen to nail them by driving a nail over a previously inserted Kirschner wire. This method is just as satisfactory as the former, provided that ample radiographic studies are made to assure the operator of a careful reduction and an optimum position for the insertion of the nail. I think that Dr. Cole will agree that an accurate reduction of these fractures even by the open method is often very difficult. Again I wish to state that this instrument devised by Dr. Cole is unique in the versatility of its application and, if used according to instructions, is practically fool-proof.

The meeting adjourned.

A. G. SCHULZE, M.D.  
Secretary.

## BOOK REVIEWS

Books listed here become the property of the Ramsey and Hennepin County Medical libraries when reviewed. Members, however, are urged to write reviews of any or every recent book which may be of interest to physicians.

OUR COMMON AILMENT. Constipation and Its Cause and Cure. Harold Aaron, M.D., Medical Consultant to Consumers Union of United States. 192 pages. Price, cloth, \$1.50. New York: Dodge Publishing Co., 1938.

THE 1938 YEAR BOOK OF GENERAL MEDICINE. Edited by George F. Dick, M.D., et al. 840 pages. Illus. Price, cloth, \$3.00. Chicago: Year Book Publishers, 1938.

DOCTOR BRADLEY REMEMBERS. A Novel. Francis Brett Young. 522 pages. Price, cloth, \$2.75. New York: Reynal & Hitchcock, 1938.

HOW TO CONQUER CONSTIPATION. J. F. Montague, M.D., Editor-in-Chief of Health Digest. Medical Director New York Intestinal Sanitarium, etc. 244 pages. Price, cloth, \$1.50. Philadelphia: J. B. Lippincott Co., 1938.

CRIPPLED CHILDREN: THEIR TREATMENT AND ORTHOPEDIC NURSING. Earl D. McBride and Winifred R. Sink. 379 Pages. Illus. Cloth, \$3.50. 2d edition. St. Louis: Mosby, 1937.

This book deals with the various phases of the handling of crippled children. It is intended for the training of nurses but contains more inaccuracies and dogmatic statements than one would expect in a text used for instruction purposes. The language has been simplified to such an extreme extent that the value of the work as a reference is lost. The illustrations for the most part are fairly good but do not, in all cases, adequately picture the condition under discussion.

The advisability of using such a book as this for distribution to social workers and the laity is questioned.

THE HORSE AND BUGGY DOCTOR by Arthur E. Hertzler, M.D. New York. Harper Bros. 1938.

The story of the early experiences of a small town doctor in the horse and buggy days, his difficulties in transportation and the establishment of a hospital, is written in a most entertaining style and so saturated with humor and horse sense that the book is being enjoyed not only by doctors but by the general public. A book of this sort, which should prove to be one of the best sellers, will do much to emphasize the importance of the personal relationship between patient and doctor, so essential to the best medical care.

C. B. D.

MINNESOTA MEDICINE



## MINNEAPOLIS SURGICAL SOCIETY

Stated Meeting, Thursday, October 6, 1938

### A PRELIMINARY REPORT ON THE INFLUENCE OF FOOD AND FUNCTION ON THE INCIDENCE OF MAMMARY GLAND TUMOR IN "A" STOCK ALBINO MICE\*

IVAR SIVERTSEN, M.D.

AND

WALDON H. HASTINGS, M.S.

Minneapolis

SEVENTEEN years ago<sup>6</sup> a preliminary report was compiled on the relationship of muscular activity to carcinoma in man. In this paper it was suggested that the lack of muscular activity may be a definite factor in the causation of or susceptibility to cancer. When the adult males in Minnesota who died during the years 1918, 1919 and 1920 were divided into six groups according to the degree of muscular activity demanded by their occupations, it was found that the ratio of cancer incidence between the most physically active and the least physically active group was one to twelve.

During the ensuing years the exigencies of private practice have delayed a scientific study of this interesting disclosure. January 1, 1937, marked a new era and studies were resumed, this time with experimental animals. Because of the present difficulty in using controlled human subjects it was decided to secure pure strain mice having a high incidence of carcinoma for experimental work. The studies on these animals which I should like to discuss this evening resulted from the following observations: (1) the cancer death rate in males actively engaged in a gainful occupation is less than the death rate of those not actively engaged in a gainful occupation and is inversely proportional to the degree of muscular activity necessary for that occupation; (2) there appears to be a recent increase in cancer accompanying the advent of the age of machinery; (3) cancer has been recognized as a degenerative disease, and, knowing that degeneration takes place in all tissue that does not function, it is thought that food and function must be factors in maintaining a normal physiological condition of the human body.

**History.**—It is a general clinical observation that neoplastic tissue can proliferate in spite of unfavorable dietary and metabolic conditions. However, when these factors are carefully controlled their influence is seen on tumor growth.

Ball and Samuels<sup>1</sup> report a profound depression in the rate of growth of the Walker rat carcinoma 265 and a decrease in the number of positive growths on implantation, following the removal of the pituitary. Voegtlin and Thompson,<sup>2</sup> using the Marsh strain of

mice, found that tumorous animals fed a diet deficient in the essential amino-acid lysine showed striking inhibition of tumor growth. Maisson and Pourbaix<sup>3</sup> found that feeding organs and extracts of organs had in some cases an acceleratory effect and in others an inhibiting effect on the growth of tar cancers in mice.

Sugiura and Benedict<sup>4</sup> have studied the influence of insufficient diets on tumor recurrence and growth in rats and mice. They found that transplants of the Flexner-Jobling rat carcinoma in rats fed a complete basic diet but limited in quantity to one-third that of the normal food requirement, survived less frequently and grew much more slowly than those in full-fed controls; that under-feeding, after engrafted tumors had well established themselves in the hosts, had no marked inhibitory effect on the subsequent rate of tumor growth; and that prolonged post-operative insufficient feeding had a distinct influence on the frequency of recurrences of spontaneous tumors in mice. Using 65 mice carrying spontaneous tumor they found that 73% of those under-fed were completely cured of the tumors, while on the other hand 18% of the normally-fed controls were free from tumor at the time of death. The average post-operative longevity in the under-fed mice was 142 days against 96 days for the full-fed controls. The gain of 46 days in the experimental animals corresponds to about 3.8 years of a man's life. In addition, the number of metastases found at autopsy was much less in the under-fed animals than in the full-fed controls.

Some studies have been made by Strong and Bittner on the "A" strain albino mice, inbred since 1912 and originally secured from H. G. Bagg. Strong<sup>5</sup> found that 90% of the breeding females of this stock had spontaneous mammary gland cancer. The average age of the tumorous mice varied significantly when different diets were fed. He also found that "A" strain mice kept on the same diet in New Haven, Connecticut, Bar Harbor, Maine, and Ann Arbor, Michigan, give the same age distribution of spontaneous tumor of the mammary gland. Bittner reports on 292 "A" strain mice, of which 88% of those living after four months developed mammary gland carcinoma at an average age of 11.5 months or 350 days. These mice were fed Purina Fox Chow food ad libitum. About 68 per cent of 421 mice were cancerous at an average age of nine months when fed rolled oats, milk and salt. The increase in the percentage of tumors and the increase in the average age at the onset of the tumor in the mice on the Fox Chow diet was attributed to the better health of the animals, allowing more to live into the cancerous age.

Bittner concludes in this paper that, "Given the cancer susceptibility constitution and the subsequent irritating factors, the average age at the appearance of mammary gland tumors may possibly be influenced by the physical condition of the individual."

**Experiments.**—In view of the promising effects of these simple dietary experiments, twenty-six "A" stock

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mice were secured from Dr. Bittner, Jackson Memorial Laboratory, for a preliminary study on dietary and metabolic factors influencing tumor incidence. These mice normally have an incidence of 88 per cent spontaneous mammary gland tumors at an average age of 11.5 months.

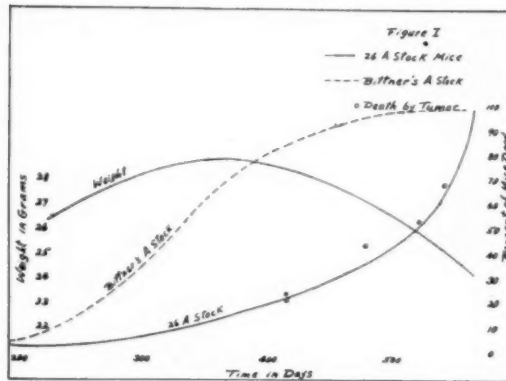


Fig. 1. Percentage of mice dead in the two "A" strain colonies and the average weight of the mice used in this experiment.

The animals were housed in wooden boxes, fed Purina Fox Chow food, and in every way possible were kept under the same conditions as other "A" stock mice reported in the literature. They were mated and produced one to three litters of young each. As Murray<sup>3</sup> and Bittner<sup>4</sup> have found no correlation between the average tumor age for animals and their breeding records, the males were removed from the colony after nine months. The only variables between this colony and Bittner's were the amount of a complete basic diet given per day and the amount of exercise.

To find the amount of food which the mice needed to maintain their weight equal to controls fed ad libitum, fourteen contemporary mice were chosen for a feeding experiment. At the beginning of the experiment Group I, consisting of seven mice, weighed an average of 27.13 grams. Group II, also seven mice, weighed an average of 27.81 grams. Group II mice fed ad libitum for eighteen days consumed 3.76 grams per day and weighed 27.83 grams at the end of that period. Group I mice were fed only enough to maintain their weight constant with those of Group II and consumed 1.94 grams per day. These mice weighed 27.16 grams at the end of the eighteen day period. Thus it was shown that mice fed ad libitum eat twice as much as is necessary to keep their weight constant. From time to time as the mice grew older this experiment was repeated and the diet of the "A" stock experimental animals was varied to meet the requirements of weight equal to mice fed ad libitum.

In addition to the restricted diet a large circular cage was constructed in which the mice were exercised daily

TABLE I.—NUMBER OF MICE DYING CANCEROUS AND NON-CANCEROUS, AVERAGE WEIGHT AND FOOD CONSUMED PER DAY BY EACH, IN MONTHLY PERIODS.

Age in months	No. dying non-cancerous	No. dying cancerous	Weight in grams (Average)	Food consumed grams per day
6.5	1		24.5	2
8.5			26.0	
10.5	1		28.0	2.5
12.5	2		28.0	3
13.5	2		28.0	3
14.5	2	2	26.5	
15.5	1		28.5	
16.5	1	1	27.0	
17.5		1	26.0	3
18.5	2	1	26.0	
19.5	9		25.0	3

for two hours. This exercising period was strictly supervised by a technician.

**Results.**—The results of our experiment are presented in Table I and Figure 1. Dr. Bittner's 292 mice fed Fox Chow ad libitum lived  $358 \pm 8.1$  days. Our mice lived  $482 \pm 6.4$  days. Two hundred and fifty-seven of Bittner's mice developed mammary gland cancer at an average of  $351 \pm 3.6$  days. Four of our twenty-six mice died of mammary gland cancer at an average age of  $463 \pm 2.3$  days. One of our mice died of primary lung tumor when 550 days old.

As our group of four mammary gland cancerous mice is quite small for significant comparison with Bittner's group we will take his group as standard and see what the chance is that four mice drawn at random from his group dying cancerous will live for an average age of 463 days. This probability is 0.00007, which means that the chances are seven in 100,000 that our four mice dying of cancer could be taken from Bittner's group. It is thus significant that the age at which our cancerous mice died was probably greatly increased by the conditions under which they existed.

In Bittner's group, twenty-four mice lived beyond 463 days. Of these, twenty-one died of cancer. In our experiment fifteen mice lived beyond 463 days, two developed mammary gland cancer and one lung cancer. This shows that the incidence of cancer has been decreased in mice living into the fatal cancerous age.

### Conclusions

The incidence of mammary gland carcinoma in "A" strain albino mice has been decreased from 88 per cent to 16 per cent in the animals studied in this experiment. The average age at which these 16 per cent develop cancer has been significantly increased beyond the average age of Bittner's colony.

It is indicated from this experiment that further work should be done using larger numbers of animals. The nature of this work should not only include food and function studies but also blood chemistry studies.

\* \* \*

Appreciation is expressed to Dr. S. J. Hillis for his assistance during this experiment, and also to Miss Julia Quickstad for her painstaking, and careful detail in feeding and exercising the mice. Appreciation is also extended to Dr. E. T. Bell for post-mortem tissue examinations.

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### MULTIPLE PRIMARY MALIGNANT TUMORS

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AND

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*Report of Case With Adeno-carcinoma of Body of Uterus, Epithelioma of Face, Carcinoma of Stomach and Squamous Celled Carcinoma of Leg with "Cures" of Nine Years, Three and Three-fourths Years, Three and One-half Years, and Six Months Respectively, and Followed by Acute Gangrenous Appendicitis With Recovery.*

Multiple cancers, according to Billroth, can only be accepted as individual and independent tumors when the histological differences preclude their being different stages of development, when each growth is shown to have sprung from its parent epithelium and when each growth has its own group of metastases.

Mercanton also adds that if one removes two cancers at one operation and the patient remains free from disease that it is practically certain that the two diseases were independent, since had either been a metastasis it is reasonable to assume the presence of other metastases which would have been incompatible with life.

Billroth reported the first cases of multiple malignancy nearly eighty years ago, and according to a study

by Warren and Gates published in 1932, a total of 1259 cases have been reported. The survey by these authors was based largely on autopsy records as were Billroth's cases and many others. We feel fortunate therefore in being able to present the following report of a live patient.

A white woman, the wife of a physician, age sixty-four, para III, presented herself for examination August 7, 1929, complaining of a blood-tinged, watery vaginal discharge of two years duration. The discharge had not been offensive nor irritating. The past history is otherwise unimportant.

Physical examination revealed the following:

The external genitalia and vaginal walls were atrophic. On the posterior lip of the small cervix there was a flat nodule about one centimeter in diameter which was raised about two millimeters above the surrounding cervical tissue. The corpus was not enlarged and was regular in outline. The cervix and corpus were freely movable and there were no masses and no induration of the pelvic tissues. The entire cervical nodule was removed, and a diagnostic curettage was done on August 9, 1929. A large amount of necrotic tissue was obtained from the uterus. Frozen sections of the tissues were made and examined immediately by Dr. Floyd Grave, who made a diagnosis of adenocarcinoma of the uterus with a cervical metastasis. Radium cartridges prepared by Dr. Charles Drake were placed in the uterine cavity and in the cervical canal. A total dose of 1500 milligram hours was given. The radium was screened with 0.5 millimeter of silver and 1 millimeter of bronze encased in 1 millimeter of rubber tubing.

The patient was placed under the care of Dr. T. A. Peppard for treatment of a mild diabetes mellitus.

On November 12, 1929, a panhysterectomy was done. The uterus was slightly enlarged and boggy. There was a pedunculated tumor 3 centimeters in diameter, attached near the left uterine cornu. The tumor and endometrium were degenerating. A diagnosis of adenocarcinoma of the uterus was made after microscopic examination of sections. The patient made a good recovery from her operation and has had no evidence of any recurrence of this tumor.

In February 1935 at the age of sixty-nine she returned with a small epithelioma of the face. No pathologic sections were made of this growth. The patient was treated with roentgen rays by Dr. R. G. Allison, with recovery.

In April 1935 at the age of sixty-nine years she returned complaining of belching of gas, vague pain in the lower abdomen, considerable rumbling, vomiting on one occasion, weakness and constipation. The physical examination was essentially negative. Hemoglobin was 73 per cent; red blood cells—4,070,000; white blood cells—9,500 and differential count normal. The urine was normal.

X-ray examination revealed a carcinoma involving the pyloric end of the stomach and extending back on the greater and lesser curvatures about four or five inches. There was 80 per cent gastric retention at three hours.

At operation on April 25, 1935 the pelvic region was palpated and there was no evidence of recurrence of the carcinoma removed six years previously. The appendix was examined and did not appear abnormal. The gall-bladder contained stones. The stomach contained a mass which began at the pylorus and extended upward about one and one-half inches on the lesser curvature and about five inches on the greater curvature. The lower half of the stomach was resected and an anterior Polya type gastroenterostomy with enteroanastomosis was made. The pathologic report by Dr. Margaret Smith was carcinoma of the stomach. Recovery was uneventful.

The fourth carcinoma appeared on the right leg about two inches below the knee as a small wart-like growth

which continued to grow until it was about the size of an almond. There were no other symptoms. The patient came to the hospital because of an attack of pain in the right lower quadrant of the abdomen. She had had abdominal discomfort for two or three weeks. The distress shifted about, sometimes on the left side, sometimes on the right side and sometimes beneath the costal margin on the right side. During the past forty-eight hours it had increased in intensity, and on the evening of March 29, 1938 she had been nauseated. There was slight fever, slightly increased pulse rate and slight tenderness in the lower abdomen particularly on the right side. The leucocyte count was 20,000 with 88 per cent p. m. ns. The history of carcinoma of the uterus, carcinoma of the stomach and the existence of gallstones complicated the diagnosis. The age of the patient being seventy-two years and the previous record of examination of the appendix with normal appearance caused the consultants to be very conservative. Finally, however, on March 31, 1938, we opened her abdomen for the third time and removed an appendix which was one-half inch in diameter and completely filled with pus. The appendix was not ruptured, and it was possible to explore the abdomen. Although there were a moderate number of adhesions present, a fairly satisfactory exploration was made and neither the upper abdomen nor the lower abdomen showed evidence of metastatic growths. The appendix was removed in the usual manner. On April 14, 1938 the stomach was examined with the x-ray and it was felt that there was no evidence of carcinoma.

The tumor of the right leg was removed, and microscopic examination showed it to be squamous celled carcinoma. The patient left the hospital on April 17, 1938 and is still in good health at the time of this report.

Multiple primary malignancies occur in 2 to 4 per cent of persons suffering from cancer according to Warren and Gates. These authors made a survey of the literature and added forty cases from their study of a series of 1,078 post-mortem examinations on malignant disease cases. Among the 1,259 reported cases there were 242 cases of double carcinomata of different systems and sixteen of these were primary carcinomata of the stomach and uterus (including the cervix), and three were of the stomach and bladder. In 111 cases, three or more malignant tumors were found.

Warren and Gates conclude that multiple malignant tumors occur more frequently than can be explained on the basis of chance and that this may be explained by a predisposition or susceptibility to cancer in certain persons, or the action of some factor favoring the development of malignancy.

Our patient still has gallstones. Gallstones have been credited as a factor favoring the development of malignancy. The question naturally arises in view of her demonstrated ability to survive major operations as to whether or not we should advise removal of the gallbladder or let the gallstones prove their ability to produce carcinoma in the patient with a special previous disposition or susceptibility to carcinoma.

#### Discussion

DR. T. H. SWEETSER: I think that you may be interested in the case of a fairly young man, just turned forty, who has survived six major operations for three entirely different malignant tumors. In 1920 our fellow member, Dr. J. F. Corbett, performed the second and third operations for glioma of the brain and there has been no recurrence of that trouble in the intervening

eighteen years. In May of this year he referred the patient to me because of gross hematuria. Cystoscopy disclosed a papillary carcinoma of the bladder, and biopsy demonstrated it to be of Grade IV malignancy. I resected the bladder wall by open suprapubic cystostomy; he has had no signs or symptoms of recurrence thus far. Later he noticed blood in his stools, and proctoscopic examination by Dr. Corbett demonstrated an annular carcinoma at the lower end of the sigmoid colon. He has survived a two-stage removal of sigmoid and rectum, the growth microscopically having been of Grade IV malignancy. Of course, it is too early to say anything as to the final outcome. Such cases raise the question of the presence in certain people of some factor of susceptibility to malignancy in general. Incidentally, I understand that this man has also survived a serious automobile accident and an attack of acute pancreatitis.

DR. MARTIN NORDLAND: I would like to know how long this patient had any symptoms of appendicitis. I noticed in examining the specimen that the appendix was not sectioned and I wondered if she might not also have a carcinoma of this organ.

DR. R. C. WEBB: I wish to thank the members for the discussion, and I believe that if you were to check your records, more cases of multiple carcinoma could be reported from this society. We have seen four other cases of multiple carcinoma.

One patient, a woman of fifty-three years, was first seen in July, 1926 and a radical operation of the left breast was performed on July 3, 1926. She returned in January, 1928, one and one-half years later, with a small carcinoma in the lower outer quadrant of the right breast. This breast was likewise removed with a radical amputation. This patient is still living, ten and one-half years after the second operation. The fact that she is still living lends some weight to the argument that the second growth was a primary one rather than a metastatic growth.

An unmarried woman, aged forty-eight, was seen in March, 1933, with a large carcinoma of the right breast. A radical operation was done. No carcinoma was found in the axillary glands. This patient was examined at intervals of three months and in March, 1934, one year later, a small lump was felt in the upper outer quadrant of the left breast which was not adherent to the chest wall or to the skin. Radical breast amputation was done and in the left axilla several large hard glands which lay high up behind the vein and artery were removed. The patient died within six months. She was treated with x-ray following both the first and second operation.

Another patient, a woman sixty-six years of age, was seen in 1923. A skin tumor of the left forearm and a skin tumor of the right side of the neck were excised with a margin of normal skin. Specimens were examined by Dr. E. T. Bell whose reports show that each was a basal cell carcinoma. This patient died ten years later of pneumonia. A postmortem examination showed no evidence of carcinoma of the internal organs.

Wynne reported a case\* of primary carcinomata of the bladder and stomach before the Minneapolis Clinical Club in 1933. This case was discussed by Dr. J. C. McCartney, Jr., who had made the pathological examination of the tissue removed at the operation and performed the autopsy five years later.

As to the appendicitis, this patient was admitted to the hospital March 29, 1938, but the appendix was not removed until March 31, 1938, about forty-eight hours after admission. She had had symptoms from her gallstones off and on, but on March 28 she had had pain in the lower right abdomen without nausea. The presence of the gallstones and the two previous operations

\*Wynne, H. M. N.: A case of carcinoma of the bladder removed by operation with death from carcinoma of the stomach five years after operation. *Journal-Lancet*, 53:168, (March 15) 1933.



for carcinoma, together with out knowledge that her appendix was normal in appearance three years previously at the age of sixty-nine, rendered the diagnosis more difficult and confusing and accounted for the delay.

### INCREASED BILE FLOW AND PRESSURE AS AN AID IN THE SURGICAL AND NON-SURGICAL MANAGEMENT OF BILIARY TRACT DISEASE

R. RUSSELL BEST, M.D. (by invitation)

Omaha, Nebraska

#### Summary of Presentation

Frequent opening of the common duct and cholangiography have proved that common-duct stones are more common than was formerly supposed, and that stones, mucous plugs, collections of inspissated bile and blood clots which remain post-operatively not infrequently produce symptoms simulating gallbladder disease. Cholangiograms have not only done much to prove this but have aided considerably in reaching a better understanding of the physiology and mechanism of the extrahepatic biliary tract. Spasticity of the sphincter of Oddi, or spastic biliary dyssynergia, may exist to the degree of completely blocking the lower end of the common duct, and increase in common duct pressure associated with this spasm may well be the cause of symptoms in the post-cholecystectomy syndrome. Various antispasmodic drugs have been used to relax the sphincter area, nitroglycerin and atropine being most commonly employed. Then by stimulating bile flow along the bile highways, namely the intrahepatic, hepatic and common ducts, a biliary flush has been obtained. This increased bile flow is accomplished by administering dehydrocholic acid (decholin and pro-cholon). Studies have been made and curves plotted to show the increase of bile flow and bile pressure (Figs. 1 and 2). After three or four days administration of dehydrocholic acid, the pressure tends to return to normal, but after withdrawing it for a few days, the pressure may again be increased by its administration. Cases were presented in which delayed cholangiograms revealed single stones, multiple stones, or other debris in the common duct and which demonstrated the flushing out of these foreign bodies by increasing the bile flow and relaxing the sphincter area. In several instances where the stones were too large to pass through the relaxed sphincter area, the method was not successful.

Immediate cholangiograms are not taken as often since the introduction of this biliary flush, for the smaller foreign bodies which in the past probably remained in the common duct without being properly appreciated or suspected, may now be removed quite easily by this method without proving their existence.

In every case with a common duct T-tube or catheter, a cholangiogram should be made before the tube or catheter is withdrawn. A 48 per cent hippuran solution has proved to be the most advantageous contrast medium, 15 to 40 c.c. usually being necessary. An immediate radiograph is taken, after which the con-

trast medium is permitted to escape from the tube for five minutes, and then the cholangiogram is repeated.

The following three-day regime is instituted some ten days after every cholecystectomy; it is also used in all patients who have previously had their gallbladders removed and that have residual symptoms, and in the routine medical management of gallbladder disease. It may be necessary to repeat the treatment a number of times or at intervals in some cases because latent infection of the ductal system may result in secondary formation of common duct stones and debris. This method may also prove to be the means of dislodging stones from the liver into the common duct.

1. Dehydrocholic acid tablets, 3¾ grain, are given t.i.d. after meals and at bedtime for three days.
2. One-half ounce of magnesium sulphate is given each morning.
3. One ounce of pure cream or olive oil is given before the noon and evening meals and at bedtime.
4. On the first day, 1/100 grain nitroglycerin is dissolved under the tongue t.i.d. before meals.
5. On the second day, 1/100 grain atropine is given in a little water before meals.
6. On the third day, the nitroglycerin is repeated.
7. If a T-tube or catheter is present in the common duct, or if a fistula exists, inject warm saline solution each day and follow with warm olive oil. Warm lipiodine is beneficial at times.

Jaundice with complete obstruction of the common duct contraindicates this method of treatment.

#### Discussion

Dr. A. A. ZIEROLD.—This evening I have heard a great deal that is interesting and stimulating. I cannot help but have a feeling of admiration for someone who can so boldly enter a field that is hedged about with so much controversy as is the biliary system.

Until about 1900 most surgeons felt that the treatment of fractures was reasonably good. They were quite satisfied with the results on the whole until the x-ray appeared. Immediately they became dissatisfied with their results. Widespread use of the cholangiogram may bring about a similar state of affairs. Either my experience has been too small or I have not been sufficiently accurate in my observations, but for the most part, I have been satisfied that people who had stones in their gallbladders and had them removed, had a reasonably good convalescence and subsequent course. After seeing Dr. Best's studies and hearing him talk, I am not at all so sure that this is the case. It may be that patients whom I assumed were symptom-free were going to someone else and detailing their symptoms to them.

Undoubtedly there must be a much greater number of cases with residual symptoms due to the original condition for which they were operated upon or treated than we appreciate. It seems also not unreasonable to suppose that of this number a great many must obtain relief spontaneously without any particular treatment. Undoubtedly a number of them must pass stones from time to time without any special treatment.

I am impressed with what Dr. Best said with regard to dysfunction of the sphincter of Oddi, which most satisfactorily explains for me the symptoms of the patient who presents for surgery with an apparently normal gallbladder without stones. It is much easier to reconcile their symptoms upon this assumption and I believe that in the absence of satisfactory x-ray findings and persistence of symptoms simulating colic a most exhaustive study should be conducted to determine whether or not this may not be a case of dysfunction of the sphincter.

With regard to the digestive symptoms of gallblad-

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der disease, I cannot help but feel that these symptoms are of dysfunction of the common duct rather than symptoms of gallbladder disease itself. It is hard for me to believe or to consider the gallbladder disease

One thing I was interested in observing in Dr. Best's cholangiograms was the appearance of the pancreatic duct and I rather expected him to say something with regard to pancreatic reflux. It seems quite reasonable

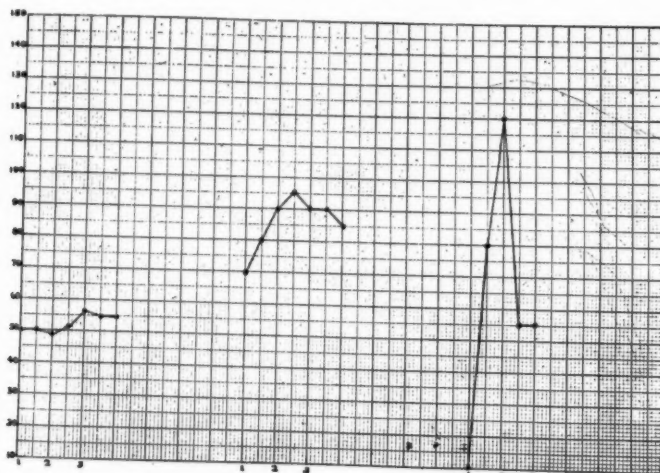


Fig. 1. Following administration of dehydrocholic acid, the general level of the intraductal pressure is increased as compared with the control level. The intravenous injection of sodium dehydrocholate results in a sudden but not prolonged rise.

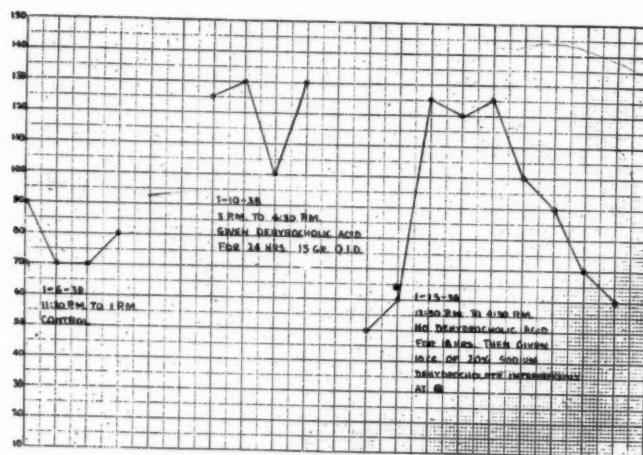


Fig. 2. Plotted curve of another patient, giving similar result. During the period of increased pressure and aided by a relaxed sphincter area a flushing out effect is provided.

which we characterize by stone formation, and fibrosis of the gallbladder wall, as an inflammatory or bacterial phenomenon. To my mind it is more the evidence of foreign body or chemical reaction. The treatment of it as an infectious process is rather difficult for me to accept. I am impressed more and more, particularly from what Dr. Best said, that many of the symptoms which we consider as chronic inflammatory disease of the gallbladder are disturbances of function or sphincter control of the emptying of the common duct.

to me that many changes in the duct as well as the gallbladder may be a result of a pancreatic reflux. The frequency with which pancreatic secretion may be obtained from the gallbladder bile is sufficient to make it a matter of importance and a matter worthy of further investigation.

I did not quite understand whether Dr. Best implied that the relaxation of the sphincter obtained by diet and nitroglycerin, atropine, etc., was intended to overcome the spasticity of the sphincter only temporarily or permanently and whether it could be first

obtained by drug action and then later perpetuated by diet. In that regard, I would appreciate his ideas as to the reasonableness of the attempts at dilatation or even section of the sphincter of Oddi.

Dr. Best spoke of stones occurring in the liver. It is hard to believe that all of these stones in the biliary tract have been shoved up by palpation and manipulation by the surgeon. Certainly indications are that many of these may be formed outside the gallbladder. We know that following the removal of the gallbladder there is a distention or dilatation of the common duct. It is reasonable to suppose that we may be turning the common duct into a functioning gallbladder. It is not unreasonable to suppose that should this obtain for any length of time stones may be developed within the common duct and within the major biliary passages in the same manner that they were formed as metabolic disturbances within the gallbladder itself. If this should hold true with the gallbladder removed, certainly it would be equally tenable in the case of the old fibrotic gallbladder which no longer concentrates and which in many instances is obstructed at the cystic duct.

This has been a most interesting and most stimulating talk, and I wish to thank Dr. Best for the opportunity of hearing him.

DR. E. A. BOYDEN (by invitation).—There are only a few words I wish to say because Dr. Best and I had our discussion this afternoon. As he talked, there were a number of things of interest that occurred to me. The first was suggested by his picture of the muscle of the gallbladder. There has been some recent physiological work at the University of Graz which demonstrates that the contraction of the gallbladder begins at the fundus, even as we had predicted from our early study of cholecystograms; then appears in the infundibulum, which, in turn, expels the bile.

Another point of interest was his mention of possible occlusion of the common duct by blood clots or debris. This is understandable in the light of Dr. Baggenstoss' recent observation that as soon as the common bile duct reaches the window in the intestinal muscle it tapers off abruptly. The same is true of the pancreatic duct. It is quite reasonable therefore that clots, for a while at least, may cause stasis.

I cannot feel enthusiastic, however, about Dr. Best's interpretation of the use of atropine in relaxing the neck of the gallbladder. Aside from skepticism concerning the "collum-cysticus" sphincter, our work has tended to raise serious doubts as to whether the human gallbladder is under the control of motor nerves. Unquestionably the animal gallbladder is. If one feeds egg-yolk to a cat that has previously had an electrode sewed to its stomach, the gallbladder will begin to empty. Then if a tetanizing current is sent through, reflexes passing from stomach to biliary tract will inhibit the emptying of the gallbladder. The same result is readily obtained by stimulating other portions of the gut tract. But if similar experiments are tried on human beings who have swallowed an electrode, the gallbladder continues to empty normally, as evidenced by frequent cholecystograms, even though the colicky pain induced by the current is severe. This has led us to suspect that there is a striking species difference in this respect between man and the smaller animals and that the human gallbladder is controlled primarily by hormones. Accordingly, I would like to ask Dr. Best whether he merely had a "hunch" that atropine would relax the gallbladder or whether he had any evidence that would permit one to discriminate between the action of nitroglycerine and that of atropine.

You physicians, of course, are primarily interested in the amelioration and prevention of disease and those of us in the fundamental sciences are most interested in the explanation of biological phenomena, but neither

of us will solve our problems without the help of the other. As an illustration of this point I would like to mention not only Dr. Best's contributions but also Dr. Leven's recent studies in the University Hospital. When some of us were working out the development of the sphincter of Oddi in the human fetus we came to the conclusion that the principal muscle in the duodenal portion of the bile passage lies around the common bile duct just before it joins the ampulla of Vater, and that this is the sphincter which causes the filling of the gallbladder. We also observed in these fetuses some muscle around the ampulla. But it was clear that the important muscle, physiologically, is the sphincter choledochus. Meanwhile Dr. Leven was finding that in 20 per cent of his cholangiograms there was indication of a reflux of contrast media into the pancreatic duct. This implied the existence of a strong sphincter ampullæ. With these new observations in mind Mr. Kreilkamp and I began examining macerated adult sphincters of Oddi, and found that one of every six autopsy specimens exhibited a prominent sphincter ampullæ in addition to a well developed sphincter choledochus. It is quite possible, therefore, that the patients that show refluxes of this sort are those in whom there is an atypical development of muscle around the ampulla of Vater. What is physiologically important, therefore, is not always the most important clinically.

In conclusion, I would like to join Dr. Zierold in thanking Dr. Best for a most interesting and instructive evening.

DR. N. LOGAN LEVEN (by invitation).—I was very much interested in this excellent paper. This matter of evacuating stones from the common bile duct brings to mind a case reported by Neuwirt in 1930. In a case of persistent biliary fistula he demonstrated three stones in the common bile duct by injecting iodized oil into the fistula. He planned to operate on this case the next day but on the following morning he found a pea-sized gallstone at the external opening of the fistula. A second somewhat larger stone was found in the stool the following day. The fistula promptly closed and the patient remained well. He ascribed the passage of stones to the cholangiography. The viscous oily solution remained on the surface of the stone and the mucous membrane lining of the bile duct. It is natural that a stone which has become slippery passes more easily through a slippery passage than a rough surface stone, especially if through the injection of a large amount of fluid the pressure in the bile passages becomes raised. In this case a small stone plugged the fistula, allowing an increased intraductal pressure to occur.

A similar procedure has long been used in the removal of ureteral stones where in cases of smaller stones spontaneous passage of the stone may occur following injection of oil into the ureter.

I would like to ask Dr. Best whether he has ever seen a case following cholangiography of the syndrome simulating the acute pancreatic edema described by Zoepfel.

Mallet-Guy, Beaupere and Armanet, Walzel, Sturm and others have reported such cases. I had one case in a series of 200 cholangiograms where following reflux into the pancreatic duct the patient on the following day developed abdominal pain, nausea, vomiting and a temperature of 103.8 degrees. By the second day the symptoms had subsided.

DR. GEORGE S. BERGH.—The administration of a choleretic together with a drug intended to produce relaxation of the sphincter of Oddi, as Dr. Best has suggested as a means of favoring the passage of stones from the common bile duct into the duodenum, appears to be based upon physiologically sound principles. The objection that I would have concerns his selection of atropine as a drug to produce sphincter relaxation.

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Although it appears to be fairly well established that atropine will produce relaxation of the sphincter in some laboratory animals, our experience, based upon direct observations in patients with choledochostomy tubes, indicates that this drug has no significant effect upon the sphincter in man. Amyl nitrite and nitroglycerin, on the other hand, will produce relaxation.

We have found that Dr. Boyden's fatty meal of egg yolks and cream sometimes will cause relaxation of a spastic sphincter when drugs such as amyl nitrite and nitroglycerin have failed. This suggests the possibility that such a meal might prove useful as a means of producing sphincter relaxation in cases similar to those presented by Dr. Best, but we have had no clinical experience with it along that line.

DR. R. RUSSELL BEST (closing).—Dr. Zierold mentioned a very practical point which was also brought out by Dr. Boyden—that probably stones and debris are often passed from the common duct with very little pain. I believe this is true, and it has no doubt been the saving point about gallbladder surgery. The purpose of this form of treatment is to flush out the ductal system, whether a spastic or atonic sphinc-

ter exists. Nitroglycerin and atropine, with or without a biliary flush, are indicated in spastic dysysnergia. Those with an atonic sphincter probably should have a biliary flush periodically in order to guard against an ascending infection.

In regard to the instrumentation advocated by several authors, I might say that we use the smaller Bake dilators but never the large dilators, for I think they tear the muscle. The cutting instrument shown by Dr. Doubilet of New York might also prove harmful.

We do not believe nitroglycerin relaxes the sphincter in all cases, and our investigation has shown the same to be true of atropine. Therefore, in our three-day regime we have combined the two.

We have had quite a number of cases where the pancreatic duct was visible, as shown in the cholangiogram, but we believe there is no danger attached to the reflux of the opaque material into the pancreatic duct.

\* \* \*

The meeting adjourned.

HARVEY NELSON, M.D., *Secretary*.

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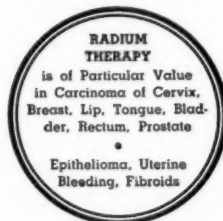
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